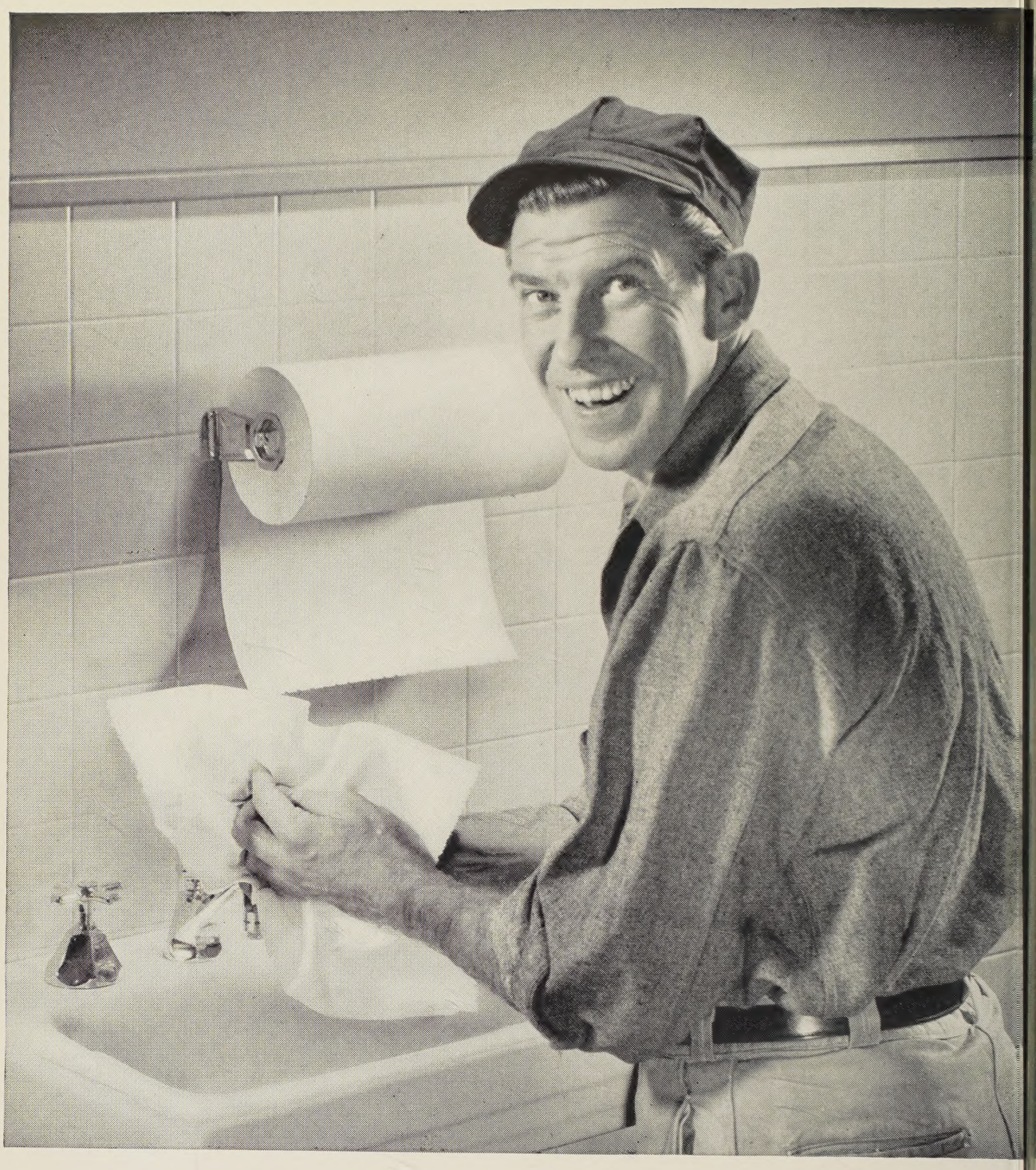
Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

MAY 1954

VOLUME 37 • NUMBER 5



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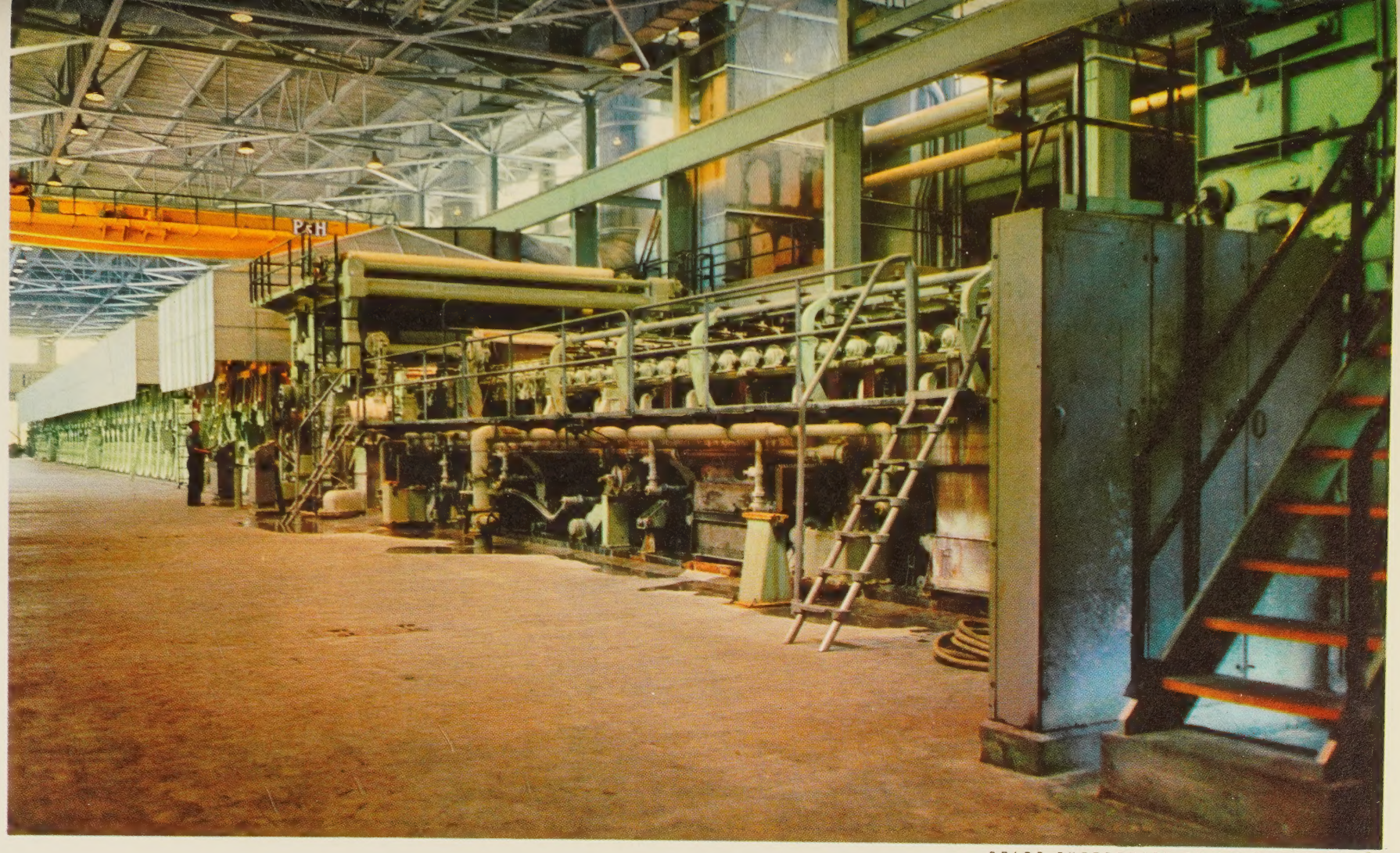

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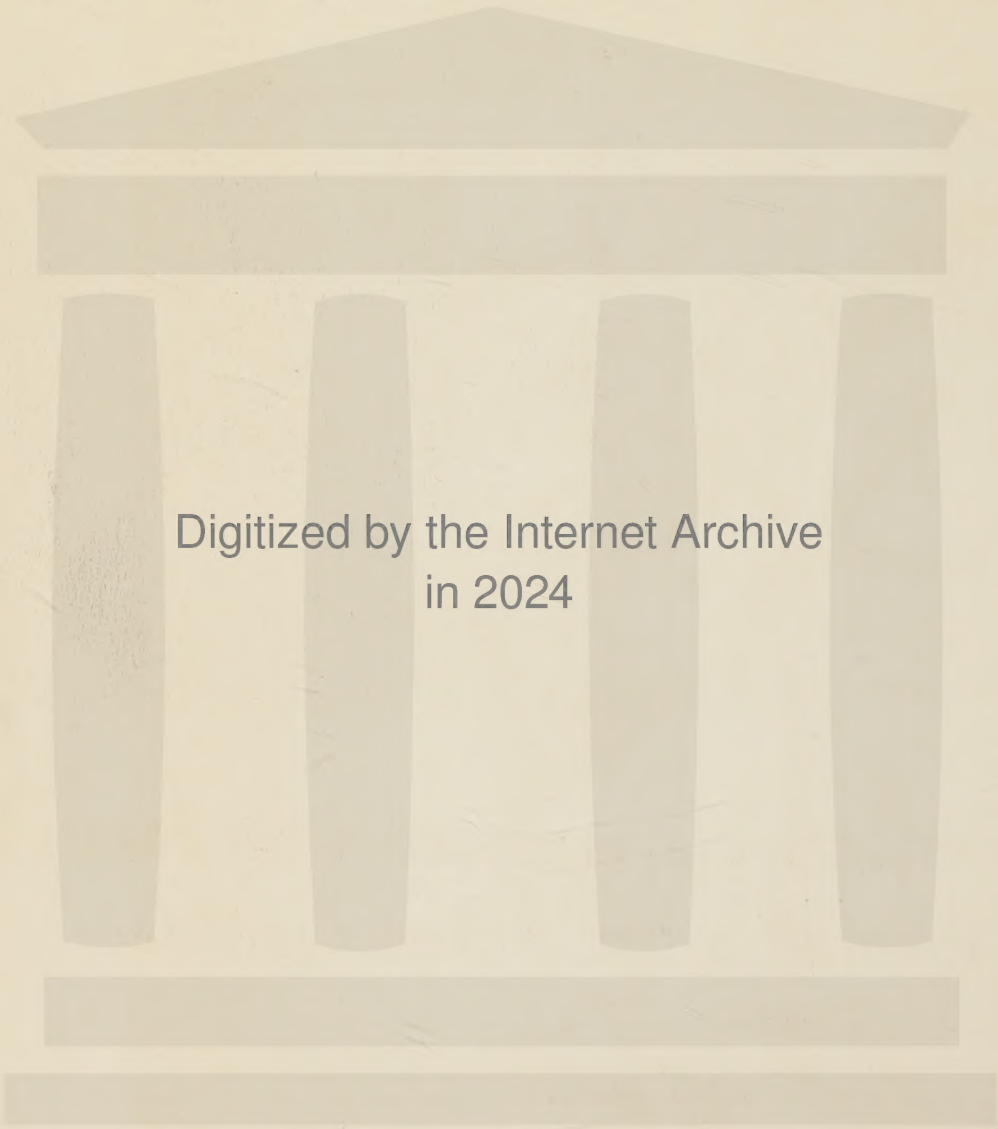

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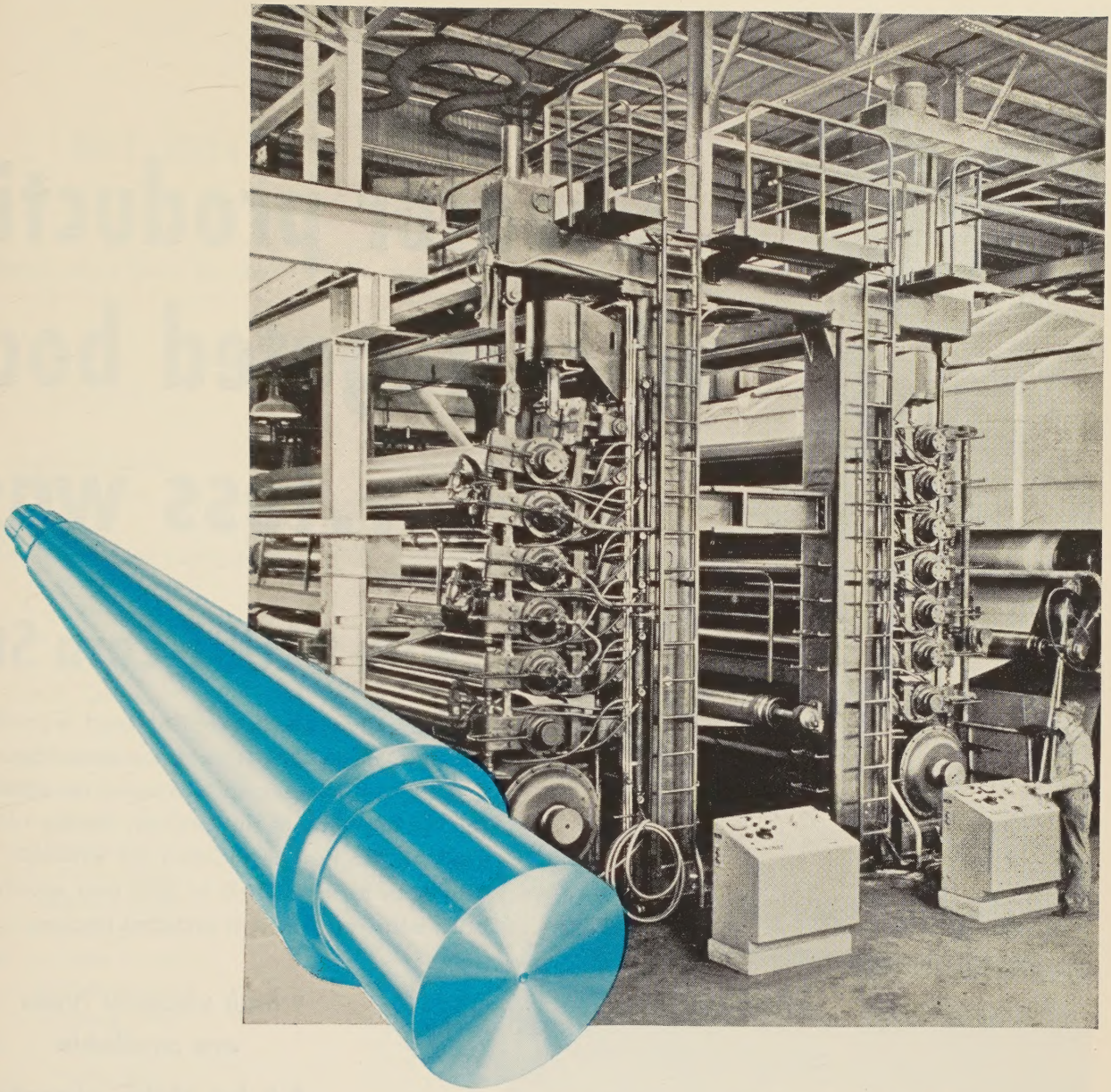

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Published monthly by the Technical Association of the Pulp and Paper Industry

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TECHNICAL ARTICLES

Comparative Analysis of Digester Corrosion Measurements, *by A. Ungar and T. E. Caywood* 177

The Continuous Preparation and Application of Silica Sols in the Paper Industry, *by L. L. Klinger* 191

Case History of an 850 P.s.i.g. Topping Turbine Installation, *by H. R. Emery and P. L. Nelson* 196

Elimination of Odors in a Sulphate Pulp Mill, *by Pietro Ghisoni* 201

The Efficiency of a Four-Stage Washer versus a Three-Stage Washer in a Kraft Mill, *by E. A. Harper and F. C. Paul* 206

The Mechanics of Stress and Strain Occurring in a Fourdrinier Wire, *by John D. Lyall* 207

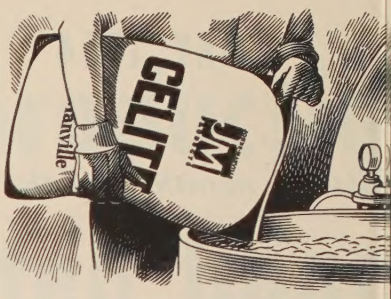
Sheet Formation on the Fourdrinier Machine, *by E. R. Finger and Z. J. Majewski* 216

DEPARTMENTS

What It Takes to be an Executive in the Paper Industry, *by H. E. Whitaker* ..... 10 A
Fifty Years with the Canadian Pulp and Paper Industry, *by J. S. Turner and J. N. Stephenson* ..... 18 A
Pulp, Paper, and Board in the United States—Review for 1953, *by W. LeRoy Neubrech* ..... 70 A
Association News and Events ..... 103 A
Letters to the Editor ..... 104 A
Personal Mention ..... 106 A
Obituaries ..... 141 A
TAPPI Divisions and Committees ..... 142 A
Reports and Discussions
Digester Corrosion ..... 144 A
TAPPI Standard
Analysis of Rosin. Proposed Revision of TAPPI Standard T 621 m-42 ..... 148 A
Recent Books ..... 150 A
Employment Service ..... 151 A
Local Section Activities
Semichemical Pulping Advances, *by J. N. McGovern* ..... 152 A
Odor Control in the Paper Industry, *by L. B. Sjostrom* ..... 156 A
Air Removal from Paper Machine Stock, *by G. D. Hughson* ..... 162 A
High Density Superbleaching of Chemical Pulps, *by F. R. Sheldon and I. L. MacGugan* ..... 164 A
Panel Discussion of Groundwood Bleaching ..... 169 A
Testing Methods ..... 176 A
Chemicals as Aids to the Papermaker and Converter, *by C. A. Markee* ..... 181 A
Some Quick and Easy Statistical Methods, *by J. D. Hinchen* ..... 182 A
Biological Oxidation—Friend or Foe, *by H. E. Orford and H. H. Heukelekian* ..... 184 A
The Saline Dilution Method of Liquid Flow Measurement, *by J. H. Mappus, Jr.* ..... 188 A
The Control of Pests of Green Lumber and Pulpwood with Benzene Hexachloride, *by R. C. Back and M. Sittig* ..... 190 A
A Quality "Efficiency" Rating for Paper Mill Production, *by R. A. Butler and T. D. Syme* ..... 192 A
Factors Influencing the Selection of Modern Rotary Lime Recovery Kilns, *by W. H. Tock* ..... 195 A
Calendar of TAPPI Meetings ..... 197 A

Published monthly by the Technical Association of the Pulp and Paper Industry at 20th and Northampton Streets, Easton, Pa. Editorial and advertising offices, 155 East 44th Street, New York 17, N. Y. Articles for publication and communications regarding the editorial content of *Tappi* should be addressed to the Editor at the editorial office. Statements and opinions expressed in articles and editorials appearing in *Tappi* are those of the contributors, and the Technical Association of the Pulp and Paper Industry assumes no responsibility for them. Subscription: U. S. and possessions $7.50; Canada $8.25; Pan American Union $9.00; Other Foreign $10.00. Single copies to members of TAPPI $0.75; Nonmembers $1.00. Entered as second class matter January 27, 1949, at the Post Office at Easton, Pa., under the act of August 24, 1912. Copyright, 1954, by the Technical Association of the Pulp and Paper Industry. An index of the technical articles appearing in the magazine appears in the Industrial Arts Index and the Engineering Index.

How Celite eliminates pitch troub



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To prove these advantages of Celite, a Johns-Manville Celite Engineer will gladly assist you in making trial runs in your mill. There is no charge for his services. Simply write Johns-Manville, Box 60, New York 16, N. Y.

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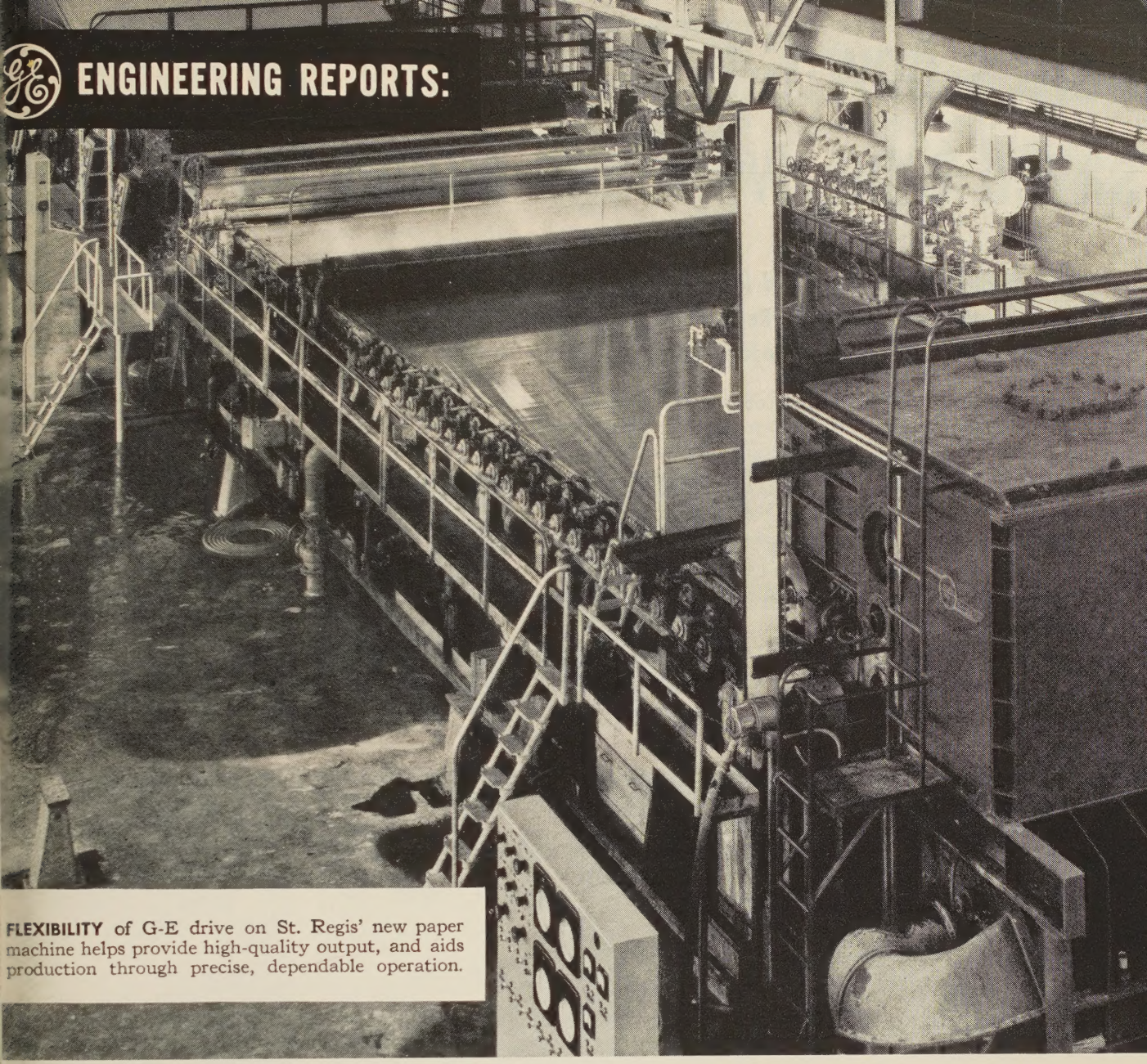


FLEXIBILITY of G-E drive on St. Regis' new paper machine helps provide high-quality output, and aids production through precise, dependable operation.

St. Regis' new 230-in. Beloit, powered by G-E sectional drive, produces . . .

300 tons of paper per day

Since 1945, demand for kraft paper has skyrocketed. Bidding for a bigger share of the expanding market, the St. Regis Paper Co. is depending on this giant Beloit fourdrinier machine located at their new, full-integrated mill at Jacksonville, Fla. Already, it has produced over 100,000 tons of kraft.

In operation only a year, the new machine has shown its versatility by turning out everything from 24-pound paper to 24-point board, to a wide variety of specifications. Operating speeds have exceeded 1900 feet per minute.

Modern drive system—Paper machine flexibility makes top-speed output like this possible at the Jacksonville plant. It is also the reason why paper and board uniformity and quality can be kept high, even with broad product diversification.

To provide the machine flexibility they needed, St. Regis had a modern General Electric multiple-generator sectional drive installed on their fourdrinier machine. With this electronically controlled system, machine operators can hold paper speeds and tensions precisely over a wide range of settings—and turn out a high rate of top-quality production, with minimum downtime.

Electrically co-ordinated—This machine is part of a completely integrated mill. The electrical system was engineered as a unit, from wood-yard to finishing room by a team of G-E specialists working with the customers' staff and consulting engineers.

The next two pages show you a picture-story of what they did.

How G-E engineering teamwork helped plan a better mill

GENERAL ELECTRIC

Here's how G-E engineering services saved time, work and money for St. Re

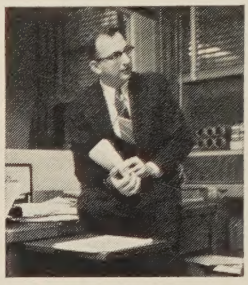
Co-ordinated manufacture and installation of G-E equipment helped St. Regis build one of the country's most modern mills.

Co-ordination made a success out of the electrical system at St. Regis' new kraft mill at Jacksonville. It simplified the earliest conferences, smoothed out equipment planning and installation, helped meet start-up dates. Through co-ordination, a team of General Electric engineering specialists were able to help St. Regis and the consulting engineers design the entire mill's electrical system as a unit. It was a big job—but it saved time, money, and engineering man-hours for St. Regis.

G-E Power Engineer
W. C. Bloomquist

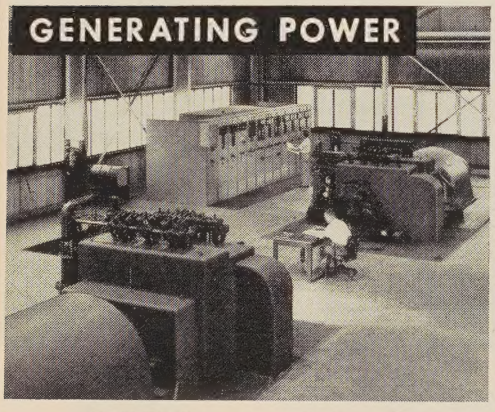
Engineering help started early—Sales and applic engineers on the G-E team were asked, in the ning stage, to make recommendations for the system. They conferred with St. Regis plan gineers, and later, worked closely with their sultants, Alvin H. Johnson & Co. Engineers, and representatives from prime contractor.

G-E "team" follows through—The rest of the engineering team was into action. The projec ordinator at Schenectady, N responsible for engineering duction, and shipment co nation, scheduled the cons tion and shipping dates apparatus. G-E product sp ists helped work out th tailed designs needed for s equipment. Because of thi

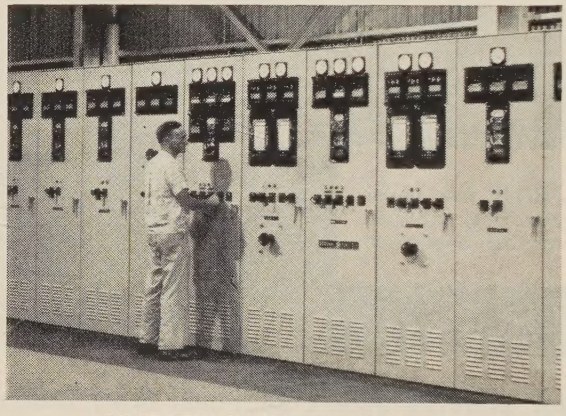


G-E Application Engineer
G. E. Shaad

GENERATING POWER

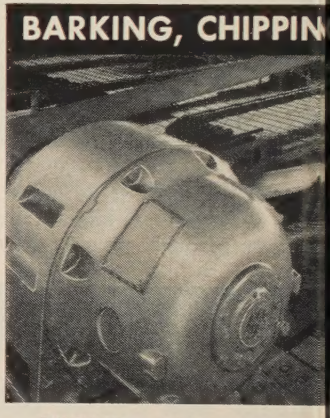


1 **POWER** for entire mill is generated by two 6000-kw G-E turbine-generators from available process steam.

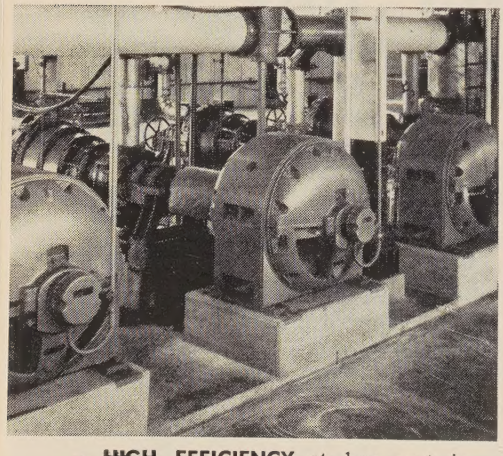


2 **FACTORY ASSEMBLY** of this turbine room 4160-V G-E switchgear helped cut installation costs.

BARKING, CHIPPIN

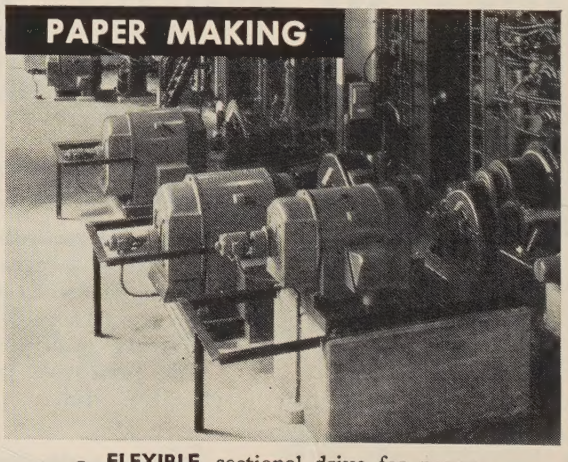


3 **RUGGED** G-E motors d 45-ft. barking drums helpin raw material movement hig

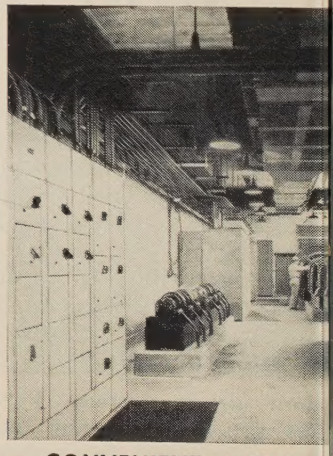


7 **HIGH EFFICIENCY** at low cost is provided by G-E 400-hp synchronous motors powering Jordans.

PAPER MAKING



8 **FLEXIBLE** sectional drive for paper machine is all G-E powered, helps assure greater production continuity.



9 **CONVENIENT, COMPA** control for wet end of 230- machine is located in o

egis engineers and the consultants were relieved of great deal of time-consuming correspondence and tails, allowing them more time for the larger aspects the project. Orders went out from Schenectady to y G-E plants throughout the country—to Fort ayne, Indiana; to Pittsfield and West Lynn in assachusetts; to Philadelphia and San Jose, Calif.

Co-ordination was just as vital during equipment nstruction as it was during first planning. It id off the same way. For instance, the construction operator's control panels for the paper machine s carried out in Wisconsin near the machine ilder to assure integrated control of the machine.

rt-up aided by co-ordinated service—Deliveries Jacksonville were rigidly scheduled. Equipment ived on site at St. Regis when needed for actual nstruction. Progress reports, issued at frequent ervals by the G-E team, kept St. Regis' receiving, erating, accounting and expediting personnel up date.

G-E Sales Engineers (l. to r.) D. F. Richardson, R. E. Griggs and H. L. Smith

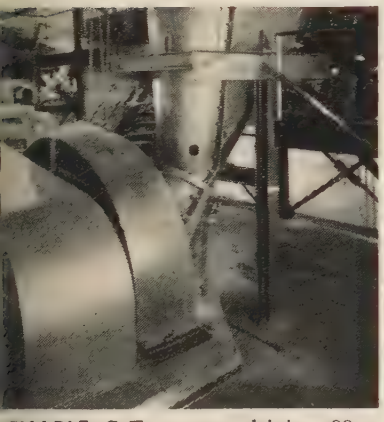
On hand during equipment installation, G-E field engineers were able to simplify the job of getting the new mill into production. They passed operating and maintenance information on to plant personnel. And at start-up time, their services helped St. Regis go into full-scale operation. The new Jacksonville mill made its first sheet of paper December 31, 1952. The dependable G-E electrical system, controlling 25,985 horsepower, has been giving St. Regis top performance ever since. 655-15

YOU CAN GET THE SAME HELP

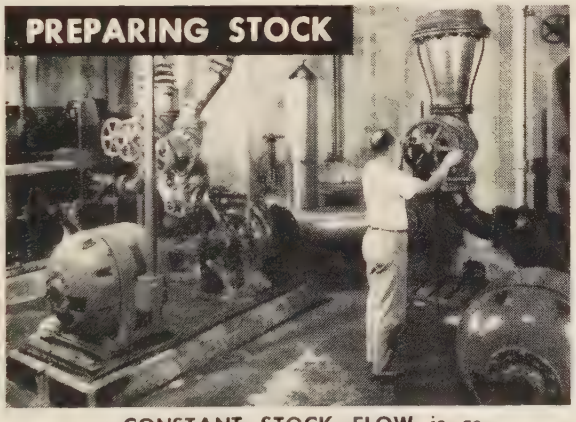
Your job of getting a new or a modernized mill completed on time can be simplified. Call in your local G-E Sales Representatives early in your plans. Let him give you the complete story on the way a G-E Apparatus Sales Division team can work with your plant and consulting engineers to expedite your new project. General Electric Company, Schenectady 5, N.Y.

Engineered Electrical Systems for Paper Mills

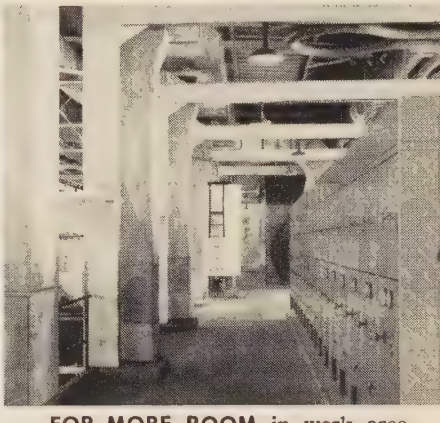
GENERAL ELECTRIC



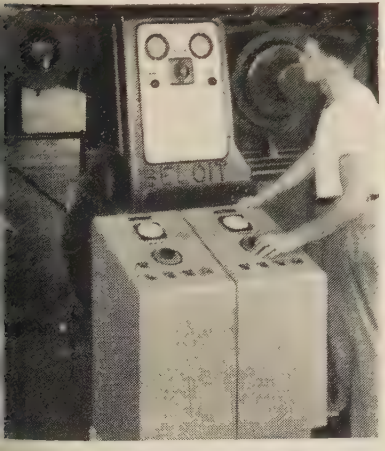
ELIABLE G-E motors driving 88-n. 10-knife chippers help reduce logs o 5/8 in. chips quickly.



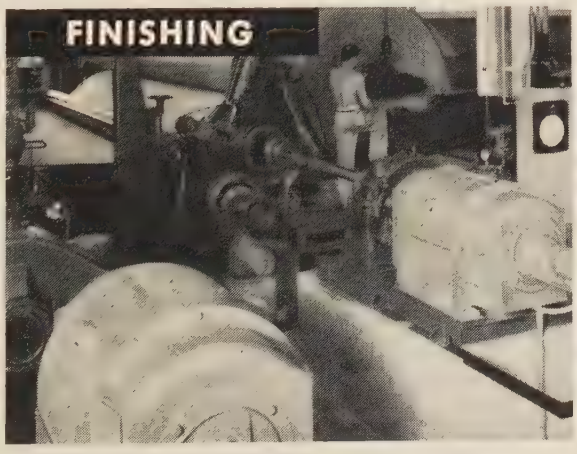
5 **CONSTANT STOCK FLOW** is responsibility of G-E pump motors located below paper machine room.



6 **FOR MORE ROOM** in work area, G-E limitamp control is located out of the way on this balcony.



RECISE CONTROL from G-E oper-tor's console means increased output f quality kraft at St. Regis mill.



11 **EASY THREADING,** higher winding speeds are possible with G-E motors and amplidyne control.

12 **FAST ACCELERATION,** deceleration provided by G-E motor helps increase slitter and rewinder output.

What It Takes to be an Executive in the Paper Industry

H. E. WHITAKER

H. E. Whitaker

I WOULD like to talk about people which is a most difficult subject, altogether too broad to cover in a few minutes at luncheon. I'm going to try to limit it to a few piece-meal remarks about people in business.

I wonder how many of you are asked from time to time just what opportunities and kind of a future there is for a young man in the paper industry. No doubt you think about it yourselves, and I wonder what you would tell a young college graduate.

For one thing, perhaps, that it is a fast-growing industry. Production has more than doubled in the last 15 years. Hundreds of millions are spent each year on new plants, and modernizing and expanding the old ones. Processes are changing constantly. There are hundreds of new products developed each year. It is wide-awake, full of life, going places.

Then, you may tell them it is a stable industry. The ups and downs are not as great as in other manufactured products. The diversity of products, and particularly the wide distribution, serving as it does every man, woman, and child in the country, all other industries and areas of the business world; all this makes for stability. And stability means job security, which seems to be an important objective of the college graduate nowadays. Well, it is for us, too.

But the young man will tell you, more likely than not, that he wants to be an executive some day. Well, the paper industry has lots of executives, and it needs lots more, in the years ahead, which is obvious to anyone.

The thing that doesn't seem quite so obvious, however, is what a young man has to do to become an executive. That is what I would like to talk about, how we can help young men learn what it takes so that they can prepare themselves for the job. Well, just what does it take to be an executive? I don't suppose any two men in this room would have the same answer.

Now I've had quite a considerable experience with executives over the past 30 years, and I've seen them from both sides, so to speak, both from below and above. I'd like to give you my ideas of what it takes:

First of all, it takes a real interest in people. The reason is that the success or failure of an executive is not measured so much by technical knowledge or experience, but fundamentally on how he handles people. His real accomplishments will rest on how well he can direct the will of a group of people working harmoniously toward the proper objectives. These people must all want the same result, they must have the right attitude and desire to achieve the results in order to exert their best effort.

An executive must like people. He must recognize them as distinct individuals, each with their own particular background of experience and particular outlook on life. He must have the patience to put up with their shortcomings and help them improve. He must recognize merit and, what is equally important, let them know he recognizes it. You know, most people are bashful, probably mostly because they are afraid of criticism—I'm that way, too. But most people like to be praised! That is one secret we are always forgetting.

He must have a deep understanding of human psychology, why people act as they do, and why some individuals act differently than others. But, most of all, he must have a genuine interest in other people.

The second prerequisite of a top grade executive is what people call the scientific type of mind; the ability to analyze things in their proper order, to put first things first, as they say, to see the important elements, and eliminate the non-essentials. This is the kind of thing that takes training and a great deal of it. We know that some people appear to have more of a flair for it than others; perhaps it is partly a matter of intelligence, but, no one is actually gifted that way. It requires constant development and practice.

One of the big advantages of an engineering or science course is that it provides direct training in the analysis of problems. But, it is just a beginning, and it takes many years of hard experience to cope with responsible decisions, experience usually developed by actual mistakes which teach one to become certain of all the facts when approaching a decision—and how to weight the facts and probabilities.

Here again, the problem always involves people—the information is supplied by individuals, the arguments are developed on the basis of personal opinions, and, whatever the decision, many people and their lives are affected.

This leads us to the word "judgment"—an overworked word we use so frequently in such a connection without ever thinking what it means. When we say a good executive must have "good judgment," we really mean he must have common sense, an ability to discriminate, an acute understanding. People aren't born with these things, they develop them through experience, but they must make conscious use of that experience, as they go along. It isn't automatic, and it is surprising how many people seem to think that 25 or 30 years' experience in itself is sufficient to assure good judgment. If it were true, we would only have to grow old to become wise.

A third attribute of an executive is a certain strength of character, which shows itself in a number of ways, but is difficult to describe in exact terms. We talk about so-and-so as having a "vigorous personality," and everyone understands what we mean. But, when you try to analyze it, you find that it does not exist within himself alone—it is only a relationship he shows to other people. The things he says, and the way he acts when he says them.

For one thing, you naturally expect such a man to have himself under control at all times; he never really loses his temper, although he may find it necessary to be forceful at times to make his points. He bears up well under strain when things appear to be getting out of hand. He talks with a confidence that supports and inspires other people. You feel quite sure he means what he says, that he has the courage of his convictions, that you will always get an honest opinion. Strength of character implies patience as well as steady

H. E. WHITAKER, President, Mead Corp., Dayton, Ohio.

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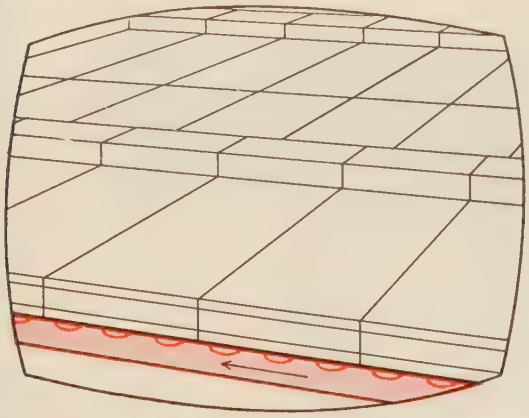

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One mill is setting coatings on 200-inch paper, on machine, at 600 feet per minute with an exposure time of two seconds. Another mill is setting coating on 30-lb. basis sheet in 0.84 seconds at 500 feet per minute.

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CHROMALOX Far-Infrared Panels are heat powered with shockproof, splashproof metal-sheathed tubular elements. Panels up to 24" x 66" can be grouped to radiate high intensities uniformly over the widest webs. Output is variable from 4 to 100%. Mechanically and electrically complete, ready to install on circuits up to 600 V.

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severence. You are impressed by a sense of reserve fo in such a man.

No doubt by this time you have thought of many o qualities which are expected, or at least desirable, in a g executive today. And, more than a few of you are q aware that there are hardly any men living who emb all of these good qualities.

But, there is one other quality I want to point out, be I close, which I think is of extreme importance and that is usually described by another overworked word—"imag tion." If you should tell your young college graduate one of the things he must have to be an executive is imag tion, he won't exactly know what you mean. Or, more lik he'll say he has that already, as he can easily imagine hin sitting in the vice-president's office in a few short years, may be director of the company as well.

Yet imagination is one of the most important qualitie all. Another word for it is "vision"—an ability to see bey today's job and plan the future. We all know that a c pany has to have a plan, a program, if it is to go anywh You can't stand pat these days! But, who is going to de the program, what do we do next, and where are we goi The boss, of course! And that is the man I've been talk about, the executive.

All executives have to have a plan—definite objecti before them, some short-term, others long-term. It app whether the executive is the president of the company head of a department, or general superintendent of the wo If they don't know what they are trying to do, heaven h them.

But it takes vision to make plans, you have to be abl see things differently than the way they are, and you hav be practical about it in order to figure out how you are go to get there. In our complex world today no one person achieve these plans, these objectives, without other pe to help him—people who are interested and convinced that plans are right.

So that brings me back full circle to the beginning ag when I said that an executive must have a real interes people, because his success or failure will depend on how he handles them, and how well he can direct their attitu and will to accomplish these plans.

I also said that an executive should have a scientific t of mind; that he must have good judgment, which is a c bination of brains and experience. He must have a str personal character of his own, and he must have imaginat to plan better things.

Quite an order! Yet there are more good jobs wait for good executives today than ever before—and very, v few good executives looking for a job. I think our big mistake in business has been our failure to spend suffic time with the youngsters in industry, to point out clearly them the way to the responsible positions, and help them velop the skills and knowledge to handle the responsibilit More and more company managements have come to rea this and are taking active steps to correct it.

It is surprising that management training has not recei greater attention on the part of the leaders of industry in past. There is nothing in the world of business that can g a man greater satisfaction than to help develop other peo and see them succeed. There is more real fun in this t anything else. You don't have to take my word for it, anyone in a position of responsibility and they will tell the same thing. Why don't we do more of it, then?

Well, I think it is because we are a little bashful, and afr of making mistakes. It is my suggestion that you study y close associates, and give this question a lot of thoug You will find it will yield you a greater return in satisfact than anything else you can do.

Presented at the Annual Luncheon of the Pulp and Paper Alumni of New York State College of Forestry, New York, N. Y., Feb. 19, 1954.

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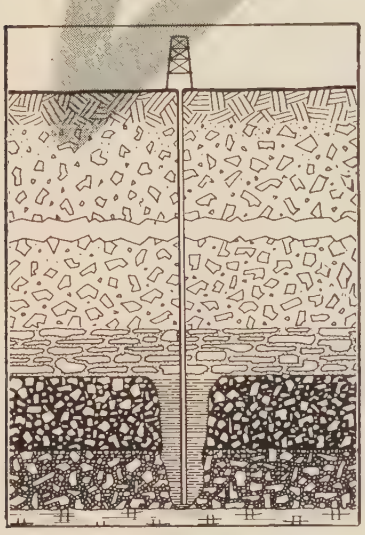
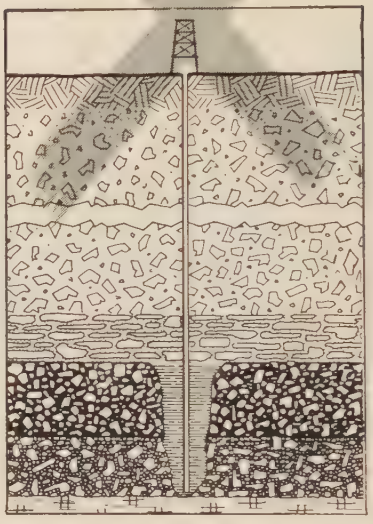
SULPHUR

...why can't *Every* dome produce sulphur?





The production of sulphur in the Gulf Coastal Region of Louisiana and Texas by Frasch Process, is from underground natural beds found in "domes." However, very domes have been found to contain sufficient sulphur, if any, to be brought into product

It is estimated that nearly 200 dome structures along the Coast of the Gulf of Me have been investigated over the last half-century but only fourteen have produced sulp in quantity.

And the presence of sulphur, even in quantity, doesn't always mean a successful p ducer. Some years ago a dome was found, explored, and proved with the result tha plant for the production of sulphur was erected at a cost of several million dollars. L it had to be abandoned because the underground conditions did not lend themselve the use of the Frasch Process.

A dome is a sulphur mine only when it can be worked economically and prod sulphur in commercial quantities.

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CHEMICAL PROGRESS WEEK-MAY 17-22

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Recent Mill Developments With Cyanamid Paper Chemicals . . .

How To Break Up Wet-Strength Broke. This problem is being solved at many mills by heating the stock in a hydrapulper with the addition of small amounts of Alum. Even tough laundry tag broke containing melamine resin is successfully repulped. Several mills which previously burned their wet-strength broke are realizing substantial savings by the use of this method.

* * *

A Smoother Latex Coating For Wrapping Paper has been made by the addition of Alwax* 251-L Size. The mill used three parts rubber latex to one part Alwax 251-L, applied to one side of the Kraft sheet . . . says the coating is 100% waterproof, highly resistant to scuffing and scratching, and feels pleasantly smooth.

* * *

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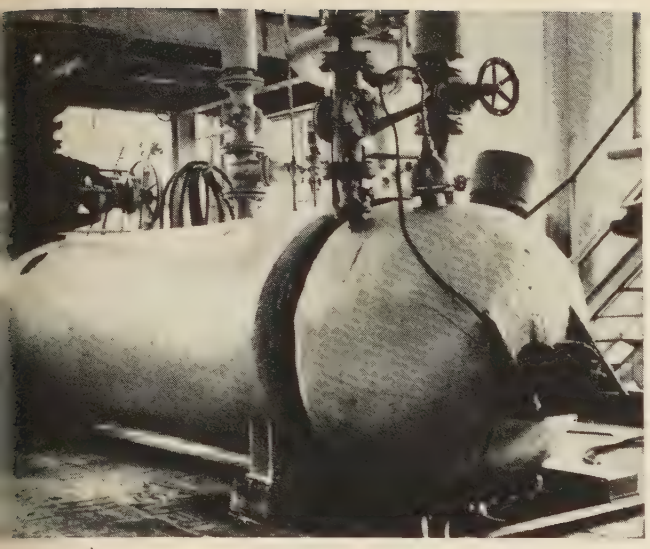
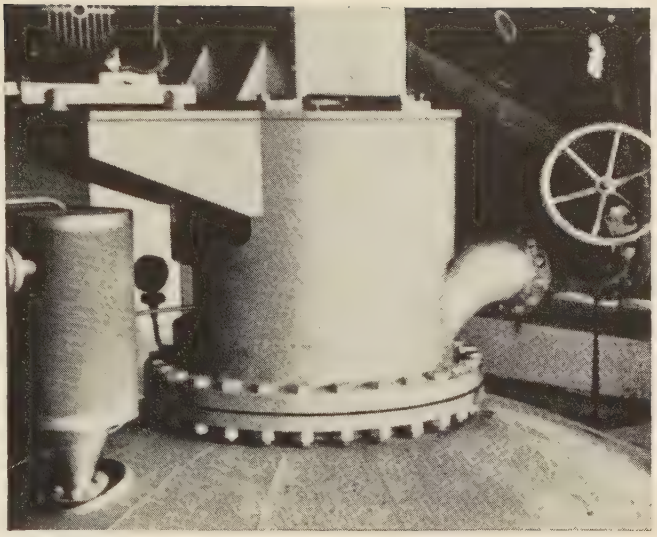
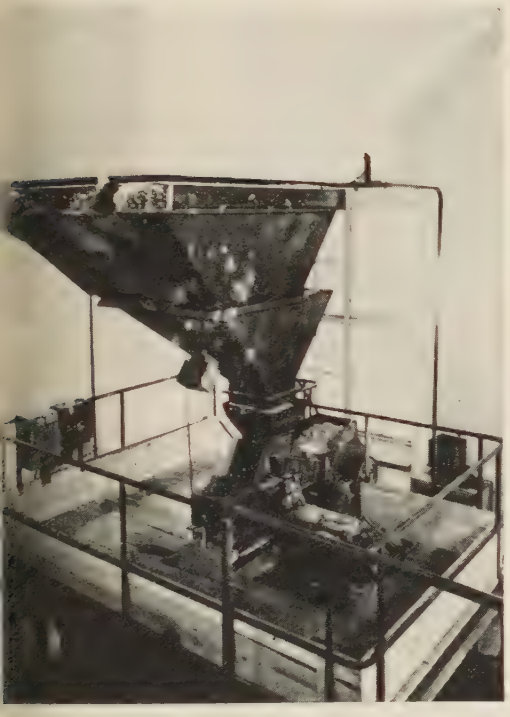


STEAMING VESSEL



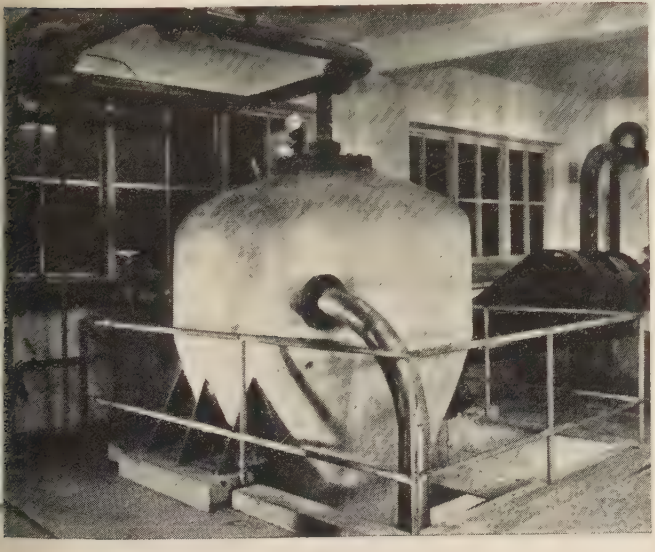
TOP OF DIGESTER

KAMYR CONTINUOUS COOKING OPERATING VIEWS

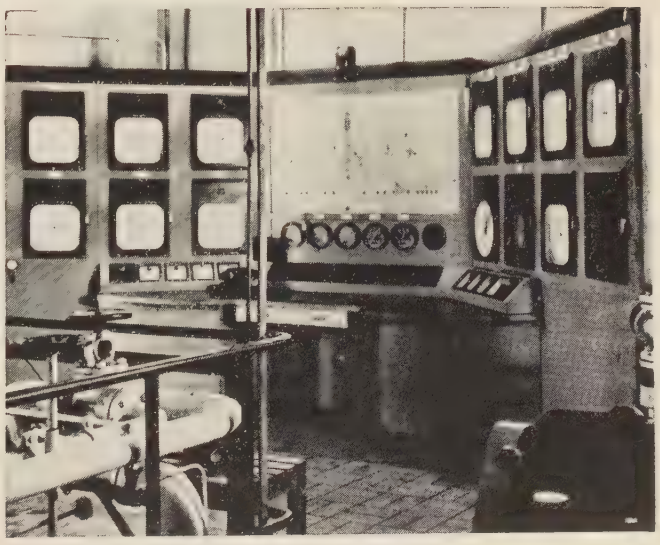


CHIP FEED

TOP OF BLOW TANK



INSTRUMENT PANEL



Fifty Years with the Canadian Pulp and Paper Industry

JOHN S. TURNER and J. NEWELL STEPHENSON

On the 50th Anniversary of the *Pulp and Paper Magazine of Canada*, the editors of that magazine reviewed the history of the Canadian pulp and paper industry, taking their notes from the issues of the past 50 years. Because of the many common interests which exist in the pulp and paper industry as a whole, this review is reprinted in *Tappi* with the Canadian journal's permission. The length of this article makes it necessary to publish it in two installments, the second of which will appear in the June issue of *Tappi*.

1903

Viewing Vol. I of *The Pulp and Paper Magazine of Canada* from the perspective of 50 years later, one is surprised that many of the problems today were regarded as problems then. Many articles appeared stressing the necessity of forest conservation, but with only vague notions as to how this was to be done, particularly as any efforts along this line would obviously cost a lot of money. A keen interest in new materials which could be pulped into stock suitable for papermaking was evidenced by the articles on esparto, straw, peat, etc. as fiber sources. Good feature articles were included, from time to time, on pulp and paper mills in various districts, such as Sault Ste. Marie in Vol. I, No. 1, by E. G. M. Cape, Cape Breton, Lake St. John, etc.

One striking difference with today was noted in the handling of accident cases. One man lost his right hand and a part of his left in a paper cutter which, judging by the evidence submitted, was due to a defect in the machine which had been previously reported to the foreman. The workman had to sue the mill in order to obtain any redress for his loss of ability to work, and the first judgment was for $2500 in his favor. On appeal, this was raised to $8000 when the employee was able to produce an eye-witness of the accident and an experienced machinist, who together were able to supply the facts as to the condition of the machine at the time of the accident. The company declared its intention to appeal the case again.

A paper machine designed by Bertrams Ltd. and installed in England, incorporated many new features, the most striking of which was the rope driving gear, which embodied "all that can be desired for driving a paper machine" at a speed of 400 f.p.m.

New York quotations for chemicals, from Vol. I, No. 1, might be of interest, in view of present-day prices. Imported china clay was $10.50, alkali 75¢, caustic soda $1.75, sal soda 55¢, and alum $1.70. The asking price on wood pulp at the mills was $14.50 at the time.

1903 seems to have been a Quebec year as far as the starting-up of new mills was concerned. St. Francis division of Canada Paper Co. at Windsor Mills began operating its 156-in. Pusey and Jones machine in the "finest mill in Canada" at that time. Other operations beginning were Price Porritt Pulp & Paper Co. at Rimouski. The Chicoutimi Pulp Co., and the Ouiatchouan Falls Pulp Co. in the Lake St. John region, the Riviere du Loup Pulp Co. at Fraserville, and the Northern Mills Co. at Ste. Adele, a Rolland Paper Co. subsidiary. The Jonquiere Pulp Co. put its board mill into production. Ontario had two mills start up—Montrose Paper Co. in Thorold and the Imperial Paper Mills at Sturgeon Falls, the second largest mill in Canada. Nova Scotia Wood Pulp & Paper Co. finished rebuilding their groundwood mill, to replace the previous destroyed by fire, and The St. George Pulp & Paper started up in New Brunswick. Fires caused an almost loss at the Strathcona Paper Mills in Ontario and considerable damage at the Royal Paper Mill Co. at East Angus, Que. The Wentworth Paper Mill at West Flamboro, Ont., was closed down by the sons on the death of their father, James Sr.

John S. Turner, Assistant Editor, and J. Newell Stephenson, Editor in Chief, *Pulp and Paper Magazine of Canada*, Gardenvale, Que.

1904

An article appearing in the July, 1904, issue, quoted *The Paper Mill*, New York, comments on the lack of success enjoyed by three New Brunswick mills in times which were generally proving profitable for other pulp and paper operations. New Brunswick being as well equipped as the other provinces as far as natural resources were concerned, other causes for failure had to be sought. The article contended that the absentee ownership policy followed in connection with three sulphite mills was the cause of failure. For instance, had the British owners of the Maritime Sulphite Fibre Co. at Chatham been better acquainted with conditions, they would have seen that the timber supply secured was not one that could be quickly exhausted. For a time the Cusack Sulphite Fibre Co. at St. John closed down, but on reopening it did not seem to be running at maximum efficiency. The St. John Sulphite Pulp Co. at Mispec also closed down, a failure partially due to poor site selection.

The leading editorial for August plumped for the establishment of a Canadian School of Forestry, and described what had been done south of the border in this respect. As a step in the right direction, it was noted that forestry lectures were to be given at Ontario Agricultural College, at the School of Practical Science, Toronto, and at Kingston.

Lord Strathcona, Canadian High Commissioner in London, said, "I am certain that Canada cannot reap the full benefit of her pulpwood resources until she carries out the full manufacture of the raw material into paper. To make pulp alone, either groundwood or sulphite, or even both, at the same time will not pay so good a return on the capital expenditure as the complete manufacture of paper would do. This is certainly borne out by facts, for whereas, during the past year two or three pulp mills have closed, more than one of the mills making paper have added to their capacity, one well-known mill having practically doubled its plant. As regards the market here there is a good opening for at least twice the quantity of newsprint Canada is now sending over. English mills are refusing orders, and the Scandinavian mills are kept well employed on orders from this market, while the consumption of newsprint is steadily increasing. So I am convinced there is ample scope for further developments in this direction at remunerative prices."

Technical developments in 1904 included the introduction of the kollergang.

Fires struck the Imperial Paper Mills at Sturgeon Falls, Ont., the W. J. Finlay & Co. mill at Strathcona, Ont., and the Alex McArthur mill in Montreal. All were planning on rebuilding. A conflagration in Toronto destroyed warehouse stocks of paper belonging to many Canadian mills. The explosion of a rotary rag boiler at Kinleith destroyed the building in which it was located and blew the other boiler into the canal. There was no loss of life.

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Imperial Paper Mills at Sturgeon Falls

The Cornwall Paper Manufacturing Co. at Mille Roches, Ont., started up its machine, a 120-in. Bentley and Jackson installation. Price Brothers became a limited company, capitalized at $2,000,000, to consolidate the various operations, and the Lake Superior Corp. took over the Sault Ste. Marie mill. The Sissiboo Pulp and Paper Co. of Weymouth, N. S., was the victim of a foreclosure sale, and the Maritime Sulphite Fibre Co. was sold at auction for $120,000. The City of St. John, N. B., bought the St. John Sulphite Pulp Co., chiefly for the water rights, with the idea of selling the mill buildings.

1905

In an address to the Canadian Forestry Association, J. C. Langelier, Chief of Forest Rangers, Province of Quebec, took issue with the province for spending only $17,000 in 1904 to protect the forest estate, when "it is worth billions, produces a revenue of $2 million to the provincial treasury, and an additional $10 million in wages."

Frank B. Gilbreth of New York has been awarded the contract for the erection of the entire plant of the St. Croix Paper Co., near Calais, Me. This antedates his famous "cheaper by the dozen" project. This mill "will contain the world's widest paper machine, 150 in., which will operate at a speed of 500 f.p.m. It will be designed and built by Pusey & Jones Co."—(Note that Canada Paper Co. already had a 156-in. machine.)

Production of sulphur begins in Louisiana by the Frasch process.

C. Howard Smith has resigned from the selling agency of the Kinleith Paper Co. of St. Catherines, Ont., to handle the products of the Cornwall Paper Manufacturing Co. in book papers.

During the year the Miramichi Pulp & Paper Co. at Chatham, N. V., began operations, as did the Pont Rouge, Que., mill of the Montreal Paper Co. and the Canada Coating Mills Co. of Georgetown, Ont. The St. John Sulphite Co. was reorganized by Stetson, Cutler & Co. of Boston, and the K leith Mills of St. Catherines, Ont., sold to W. J. Gage & Co. Ltd. Royal Paper Mills at East Angus the Brompton Pulp & Paper C Bromptonville, both near Sherbr Que., closed down.

1906

Articles appearing in 1906 ha subjects, among others, the treat of paper mill waste, woodlands ters, the tariff question, kraft b paper, and wood flour. An articl "Sulphur vs. Pyrites" by Her Frasch, president of the Union Sul Co., of Louisiana, told how his pany had broken the Sicilian mono and, not unexpectedly, stressed merits of brimstone over pyrites. drew a rebuttal from Ernest Sjostedt, chief metallurgist of the I Superior Power Co.

The first of each year a numbe notices appeared in the magazine knowledging receipt of calendars w from the descriptions, lacked the glamour of those of present day. Wonder what would have happened ye olde time editor received one of the current Billy W series?

"The pulpwood forests are practically inexhaustible, pulpwood means money," states Matthew Lodge of Chath N. B., with reference to the territory north of Cobalt, Ont

A description of Arthur D. Little's laboratory at 93 B St. in Boston was followed by a similar article on J. A. Cew's layout in Montreal.

The Reeves drive made its appearance.

"Each year pulpwood operators have to go farther farther back for their supplies. It is not long since that it not thought profitable to haul pulpwood in Ontario f points as far distant as North Bay, but this year pulpw being got out in quantities on the T. and N. O. Railway, miles beyond North Bay. The Ontario mills are now pa

Groundwood pulp mill of the St. George Pulp & Paper Co. in New Brunsu

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The Kinleith Mills at St. Catherines, Ont.

its paper. A comparison is mad
tween two towns in Quebec provi
"In one of these towns is a
plant where wood is cut up, barke
on cars, and shipped to the
States; 56,000 cords of pulpwood
through this mill last year. Er
ment was given to less than 50 pe
In 10 years the change in the p
tion of this town has been scarcel
ceptible.

"In the other town there is a
mill. Last year about 78,000 co
pulpwood passed through this
Employment was given to over
men. In 10 years the population
town has grown from 300 to over

Some titles of familiar processe
problems began to appear over the
ous feature articles, such as
trolytic Bleach, Static Electricity
Paper Machine, Freight Car Shor
Forestry College for Ontario Proj
and Turpentine from Pulp Mill Waste.

Interest in sources of fiber other than wood and clotl
tinued, with bagasse being a hardy perennial. Other
cussed consisted of banana fiber and barley straw.

Basalt lava stone beater rolls received both advertisin
editorial attention.

Paper napkins made their appearance in Germany w
mixed reception from both public and manufacturers.

The prospectus appeared in the *Pulp and Paper Ma*
of the first Pulp and Paper Handbook, which was bounc
the Canadian Textile Directory. This combined book
out finally in 1908 over the imprint of Biggar-Wilson
and when the Siamese twins were finally separated, the
book became the predecessor of the present Pulp and
Directory.

1907 news note: J. R. Booth of Ottawa is a "prac
prohibitionist. He has offered to give the City C
$2000 as a recompense for any revenue the city might lo
withholding licenses next year from three or four pre
where liquor is now sold in the neighborhood of his mills c
Chaudiere.

A news item notes that Frank Ford, of St. Raymonc
left the paper manufacturing business, and is now contra
to build paper and pulp mills and dams, etc. Being a thor
engineer, he is sure to make his way in this new departure

J. D. Rolland, president of the Rolland Paper Co.,

$4.00 a cord for spruce and $3.00 for balsam, delivered at stations in the region of North Bay. Most of this wood is being consumed by the mills in the Niagara peninsula."

E. B. Eddy died. He was born in Bristol, Vt., in 1827, and passed over 50 years in the Canadian pulp and paper industry. He built his first mill in 1888, lost his entire plant by fire in 1900, but on his death had 27 mills with over 2000 employees. He was succeeded as president of the company by W. H. Rowley, who had the misfortune to lose his wife the day after his elevation to this office.

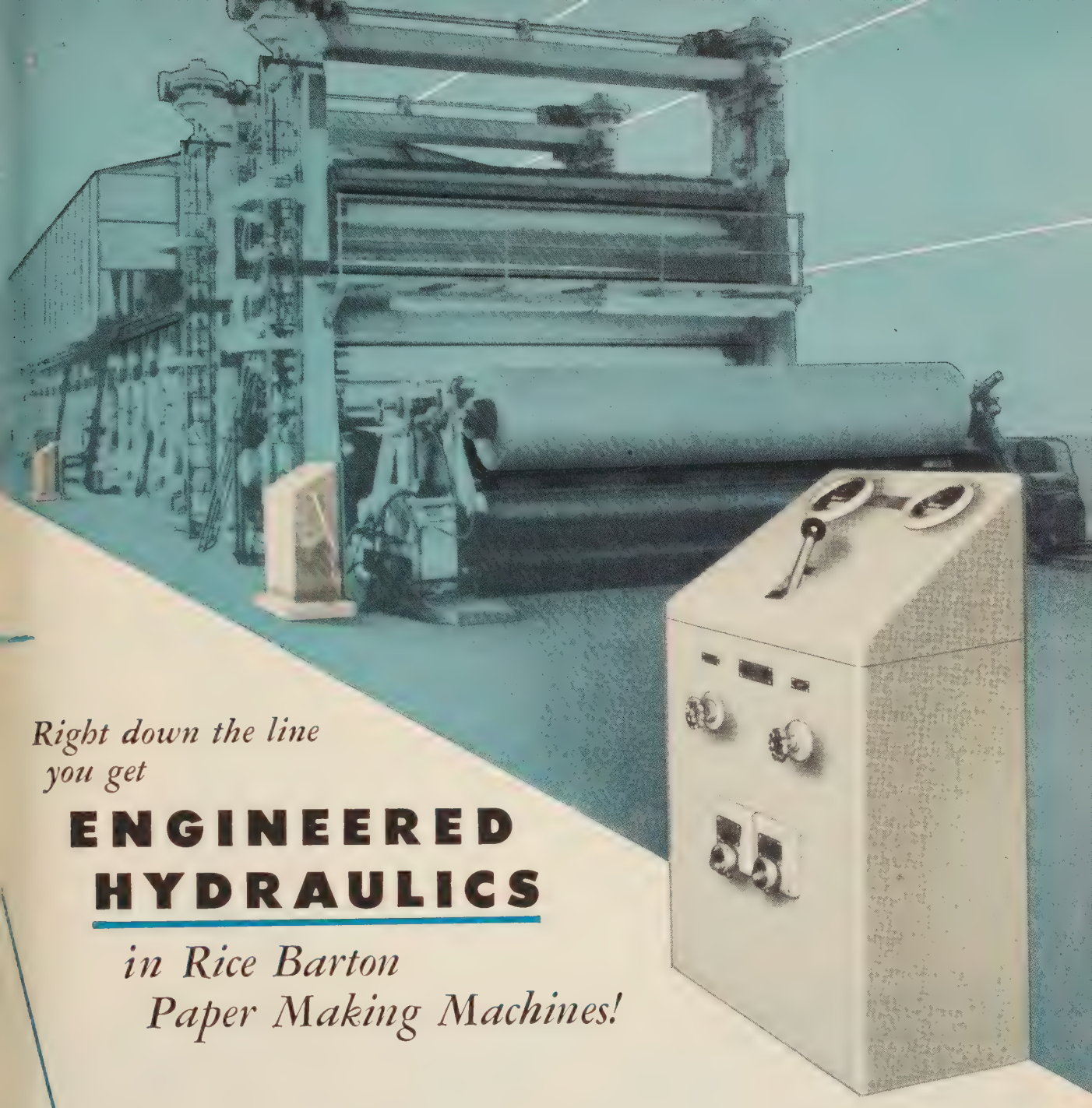
Two fires took a terrific toll at the Chicoutimi Pulp Co., practically destroying the mill. There were also fires at Dominion Pulp Co., Chatham, N. B., and Toronto Paper Co. The benzene storage tank building at F. W. Bird & Sons roofing plant at Hamilton, Ont., was blown to bits due to a lantern igniting the fumes. There were no fatalities. Union Bag & Paper Co. bought the mill and water power equipment at Grés Falls, Que., just above the Shawinigan power station at La Gabelle, pictured on the 14¢. stamp. The Canada Coating Mills Ltd. at Georgetown, Ont., opened, as did the Lincoln Paper Co. at Thorold. The Imperial Paper Mills at Sturgeon Falls, Ont., filed a petition in bankruptcy, and the Peribonka Pulp Co. in the Lake St. John region failed. Sales of the Royal Paper Mills at East Angus, Que., and the Cushing Sulphite Fibre Co. at Pleasant Point, N. B., were reported.

The real news story of the year as far as the mills were concerned, however, was the riot at Buckingham, Que. Workers in the Maclaren mill had demanded a 25¢-an-hour increase, which was refused by the management, who took that opportunity of closing down the mill, a decision arrived at due to a poor pulp market and low water conditions as well as the labor troubles. Some men were employed, under the guardianship of 40 constables, to clear away some wood in the river which was blocking navigation. This group was attacked by the strikers with stones and revolvers, and three persons were killed.

1907

The following quotation from *The Ottawa Citizen* indicates that the public mind in 1907 was slowly awakening to the waste incurred by a country which exports its pulpwood and imports

The old St. John Sulphite Co. mill at Fairville, N. B., now Irving Pulp & P Ltd.



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elected president of the Canadian Manufacturers' Association.

Those who handled their last roll of paper were W. C. Finlay, president and manager of the Montrose Paper Mills in Thorold, Ont., and John Conlon, president of the Lincoln Paper Mills in Merritton.

The Robitaille limits at Cascapedia, Que., on the Gaspe Coast, were bought by Senator Edwards for $400,000. These limits were 373 sq. miles in extent, and Mr. Robitaille had originally paid for them at the rate of $8.00 per sq. mile. Another limit sale reported was that of the Breakey tract to Brown Corp. at a $3.00 rate.

Fires occurred at the Union Point Pulp Mill, St. John, the Dominion Paper Co. in Chatham, and the North River Lumber Co. in St. Anne's, all in New Brunswick, and the Sault Ste. Marie mill burned, dumping the driers into the raceway and killing one employee. Dams were begun for future mills at Grand Falls, Newfoundland, and Fort Frances, Ont., the Davy Pulp Mill at Thorold opened, and a paper machine was installed at the Dominion Paper Mills on the Nicolet River in Quebec. The old Don Paper Mills in Ontario were sold to Robert Davies, and the mills at East Angus and Bromptonville in the Eastern Townships combined.

1908

The year 1908 seems to have been a comparatively quiet one, with the Panic of 1907 having an effect on the pulp and paper market. During the year a number of mills closed down for varying periods, including such large ones as Riordon Paper Co. There was some activity in developing a Japanese market for Canadian pulp. The American Newspaper Publishers' Association began to be extremely vocal at about this time, and the reciprocity question also evidenced some prenatal kicks.

Papers printed ran to greater specialization, but there was little attempt made to departmentalize the magazine, so that serious studies, market comments, and filler material formed a somewhat hodge-podge setup. One of the earliest articles on reforestation appeared, an address delivered by Prof. B. E. Fernow, Dean of the Faculty of Forestry, University of Toronto, before the Canadian Manufacturers' Association.

Forest fires took a heavy toll, one causing the loss of 150,000,000 f.b.m. in the Lake Nipissing area of Northern Ontario.

1908 news note: J. R. Booth sprained his ankle.

Major J. Fred Ackerman, president of Perkins Go Co. and of the Ouiathouan Falls Pulp Co., Chicoutimi died.

A peculiar tragedy is reported from Queenston, Irelan dispatch stating the barque *Germanic*, of Weymouth, had foundered in mid-Atlantic. The captain had been by a falling spar the moment when the *Germanic* sank remaining seven of the crew in the second boat are be to have been lost. The foundering was caused by the of wood pulp, which became flooded during heavy weath swelled, bursting the decks and opening the seams.

Good progress was reported in British Columbia c construction of three important mills in that area. were: The British Canadian Wood Pulp & Paper Co. a Mellon; Canadian Pacific Sulphite Co. Ltd., at Swanso and the Bella Coola Pulp Mills Co. at the place of the name.

The North Shore Railway & Navigation Co. began port pulp from their mill at Clarke City, Que., next to Islands. The Cornwall Paper Manufacturing Co. at Roches, Ont., closed up. Fires broke out in Lake Su Consolidated Co. mill at Sault Ste. Marie with one fa and the Lincoln Paper Co., also in Ontario, lost one of paper machines in a blaze.

1909

The American Newspaper Publishers' Association chipping away at the newsprint industry as far back as A circular issued by John Norris, secretary, asserts that, the tariff on newsprint was fixed to advance and protec pay of labor, no advance was given, in the paper industry also states that paper mill workers in all parts of the U States are paid an average of only $1.55 a day, which i than that accorded any other class of organized labor. other charge by Mr. Norris is that while the papern based their 1907 increase in price of newsprint to $50 pe upon the representation that the cost of labor had bee creased 50% by reason of the change of hours from 12 to per day, the fact is that only 29 mills had changed to thi tem, and that 215 had continued on the 12-hr. plan.

1909 news note: J. R. Booth. had a cold.

William Randolph Hearst stirred up quite a bit of in by his projected purchase of extensive pulpwood limits a

Don Paper Mills in the Don Valley near Toronto

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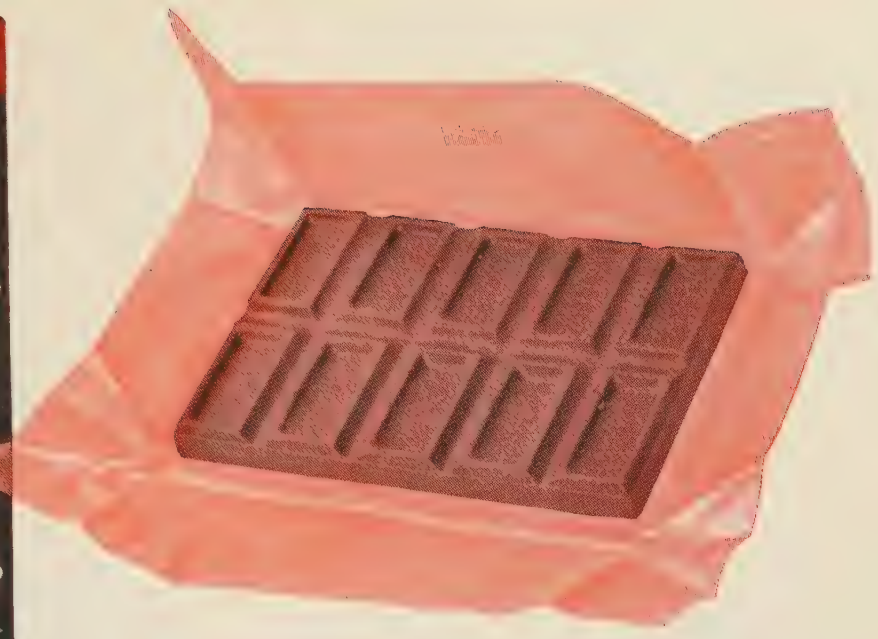

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D'Espoir, Newfoundland, with the idea of erecting a large pulp and paper plant.

A number of large eels clogged the waterwheel of a United States paper mill and forced it to close down temporarily.

James D. Finley, superintendent of the Alex. McArthur & Co. mill at Joliette, Que., died at the age of 63.

A real cloak-and-dagger story appeared in the May issue, reporting an apparent attempt by representatives of American paper manufacturers to extort information by bribery as to the cost of making paper in Canada at the Laurentide mill, Grand'Mere, Que. This was supposedly to be used before the Congressional Ways and Means Committee.

Mills beginning operations included New Brunswick Pulp & Paper Co. (a kraft mill) at Millerton, McLeod Pulp & Paper Mills, Milton, N. S., (on pulp and boxboards), Don Valley Paper Mills at Toronto, Colonial Wood Products at Thorold opening a pulp mill, and Western Canada Wood Pulp & Paper Co. at Quatsino Sound, B. C. This mill was bought out the same year by British-Canadian Wood Pulp & Paper Co. of Port Mellon, B. C. The year's most important opening was that of the Anglo-Newfoundland Development Co. at Grand Falls, Newfoundland, attended by Lord and Lady Northcliffe and many other dignitaries from both sides of the Atlantic. The St. Maurice Industrial Co., forerunner of Brown Corp., erected a rossing mill at La Tuque. St. Raymond Paper Co. closed down, and the Ford mill at Portneuf, Que., burned. The Montrose Paper Co. at Thorold, Ont., closed but reopened after a reorganization. The Ottawa Pulp & Paper Co. was liquidated, and Riordon Paper Mills Ltd. merged with G. H. Perley & Co. Edwin Crabtree & Sons Ltd. was incorporated, and the Montreal Paper Co. at Portneuf had the misfortune to have a 60 by 30-ft. wall collapse into a canal, taking some machinery with it. It was rumored that this mill was sold to F. W. Bird & Son of East Walpole, Mass., but this actually did not happen until a merger at a later date.

1910

One of the important events which occurred early in 1910 was the formation of a forestry school by the Quebec Provincial Government. This was headed by G. C. Piche, chief of the Quebec Forest Service, and 12 students took the first course, which was to take 2 years and was to cover both the theoretical and the practical applications of forestry. In addition, they were required to put in 3 months at the forest nursery at Berthierville, Que., and a year and a half in the Quebec Forest Service. They were also supposed to spend 3 months before graduation in a woodworking establishment, and to write a thesis based on their observations and experiences.

A very important Quebec Provincial Government announcement was that no pulpwood cut on Crown lands could be exported from the province as a raw material.

A comprehensive article on one of the basic principles of mill safety, the need for guards on machinery and stairways, was written by Thomas Kelly, factory inspector for the Ontario government. This was one of the first on this subject to appear.

The Grand Trunk Railway strike caused the same type of difficulty for the paper mills that they experienced not so long ago under similar circumstances. Manufa products piled up due to a shortage of shipping fa and several mills were forced to shut down after all storage space was used up.

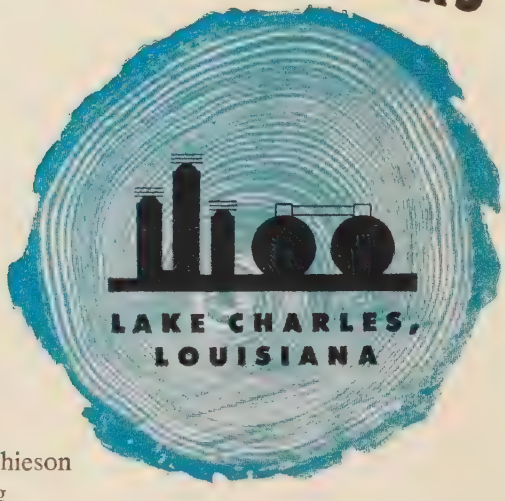
The name J. R. Booth looms large through this enti ade, both in the paper and lumber fields. Mr. Booth h inspired mixed feelings among his associates and empl but it is interesting to look back and see in how ma stances he was out in front of the rest of the mills with tices which are taken for granted today, such as the th hr. shifts he instituted in the machine room. Mr. Booth kindhearted man but one who hated to be pushed ar He could be tough with the beater room employees who s for the short shifts to match those enjoyed by the p makers, whom he considered as skilled labor. On the hand, he paid full wages to all employees, during the down occasioned by the Grand Trunk Railway strike, fig that he could better afford to lose the $35,000 involved the men.

Guy Tombs, Montreal manager of the Canadian Nor Railway, stated that the pulp mills along that line turne 516,000 tons of pulpwood per annum and 140,000 to newsprint and cardboard.

The Ocean Falls Pulp & Lumber Co. was organized to a mill on Cousins Inlet, B. C. Those interested were Wi Price of Quebec, J. H. Campbell of Vancouver, L. W. Da Seattle, J. H. Benn of London, and J. S. F. Lowson of S ford-on-Avon. Canadian Wood Pulp & Paper Co. at Mellon on Howe Sound was sold to an English syndicate Quebec Province Price Brothers bought out the Jonq Pulp Co., the News Pulp & Paper Co. took over the St.

Canadian Pacific Sulphite Co., Ltd., Swanson Bay, B. C.

BLUE CHIPS FOR ANHYDROUS AMMONIA USERS



Pulp and paper manufacturers converting to ammonium bisulphite pulping are looking to Mathieson as a dependable source of supply. They are finding that Mathieson, one of the nation's largest producers of ammonia, is able to maintain reliable delivery schedules from three plants adjacent to major pulp producing areas and other industrial centers.

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North Shore Railway & Navigation Co. mill at Clarke City, now Gulf Pulp & Paper Co.

mond Pulp and Paper Co. adding a groundwood mill. Brown Bros. mill at La Tuque opened. In Ontario the Foley Rieger Pulp & Paper Co. bought the old Keefer mill at Thorold and converted it to groundwood, and the Colonial Wood Products Co. also manufactured groundwood pulp in the same town. The Campbellford Pulp & Paper Co. opened at the town of the same name, and J. R. Booth installed a new board mill.

Mills which closed down were the St. John Pulp & Paper Co. at Mispec, N. B., the Miramichi Pulp & Paper Co. at Chatham, N. B., which was taken over by Stetson, Cutler & Co. and the Pacific Coast Sulphite Pulp Co. Fires occurred at the Nicolet Falls Pulp Co. near Danville, Que., and at the Miramichi mill mentioned above.

1911

In contrast to the years on either side of it, 1911 did not produce much in the way of news as far as the pulp and paper industry was concerned, outside of the reciprocity question. The mills were unusually plagued by low water that year, and there was some agitation that sulphate odors should be minimized. The Bache-Wiig drum barker made its appearance. This was a solid drum-type barker which removed the outer covering of the logs by friction only, with one batch being inserted at a time.

The collapse of the penstock at Powell River in B. C. held up the start-up of the paper machine. The Oriental Pul Paper Co. began operations at Bella Coola, B. C. In Que the National Paper Co. opened at Valleyfield, as did the G Falls Co. at Cap de la Madeleine, The Brompton Co Bromptonville, and the Eastern Canada Power & Pulp Co Clermont, near Murray Bay. In Ontario the Georget Coated Paper Mills Ltd. began operations, and the Impe Mills at Sturgeon Falls were finally sold, after 4 years of i ness. for $900.000 to Dominion Bond Co. which was also terested in the Spanish River Co. mills at Espanola. An tempt had been made previously to auction this property, there were no bidders and the receiver, E. R. C. Clarkson, forced to negotiate a private sale.

1912

H. R. MacMillan, M.F., forestry branch, Department o Interior, Ottawa, gave a paper entitled "A Progressive Fo Policy Requires an Investment of Capital" at the an meeting of the Canadian Forestry Association. Besides ur that intelligent forest management required a monetary lay to implement it, he stressed the need for "the establ ment of experimental laboratories where skilled chemists pulp and paper experts would be encouraged to develop u for woods and wood waste now thought unsuitable for us wood pulp manufacture." A later 1912 number carried

Modern view of the Sault Ste. Marie mill, then operated by the Lake Superior Consolidated Co.

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CHEMICAL PROGRESS WEEK-MAY 17-22

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CATO STARCH improves formation and finish of many papers.

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news of his appointment as chief forester for the Province of British Columbia.

An article hailed the fact that "textiles from paper yarns have now got beyond the experimental stage, and are put on the market in a large variety of fabrics."

Two articles discussed the production of pulp from peat. The conclusion reached was that the technical difficulties were considered too great and the process too expensive to be worthy of further pursuit. A later article mentioned a process patented in England by two German chemists, who proposed to treat the peat with a warm solution of chloride of lime, dilute hydrochloric acid, and potash or soda.

The opening of the Panama Canal and the decision of the U. S. Treasury Department to admit paper from British Columbia free of duty both gave the budding West Coast pulp and paper industry a considerable stimulus.

A discussion on the use of jack pine for pulp concluded that, "it seems beyond doubt that this wood may be advantageously used, either singly or in various combinations, at least in the cheaper grades of paper."

The tilted type of continuous barking drum began to be used, assisted by hand peeling or disk barking arrangements to take care of blocks not completely cleaned.

A severe loss to the industry was the death of J. D. Rolland.

Four boats were engaged in the transport of pulpwood from Anticosti Island in the Gulf of St. Lawrence to ports as far distant as Portland, Me.

While it is sometimes difficult to tell exactly when a new mill starts from back numbers of the magazine, the following are believed to have begun operations in 1912, or were just about ready to do so:

Interlake Tissue Mills, Merriton, Ont., opened up with J. J. Herb as superintendent. He is described as being "a thoroughly capable and experienced papermaker."
Lake Superior Paper Co., Sault Ste. Marie, Ont.
Price Brothers & Co., Ltd., Kenogami mill.
Wayagamack Pulp & Paper Co., Cap de la Madeleine, Que.
Garden City Paper Mills, St. Catherines, Ont.
Powell River Paper Co., Powell River, B. C. (controlle Willamette Pulp & Paper Co.).
Ocean Falls Pulp Co., Ocean Falls, B. C.
Western British Columbia Paper Co., Sapperton, B. C.
British Sulphite Fiber Co., Howe Sound, B. C. (Mitsche process).

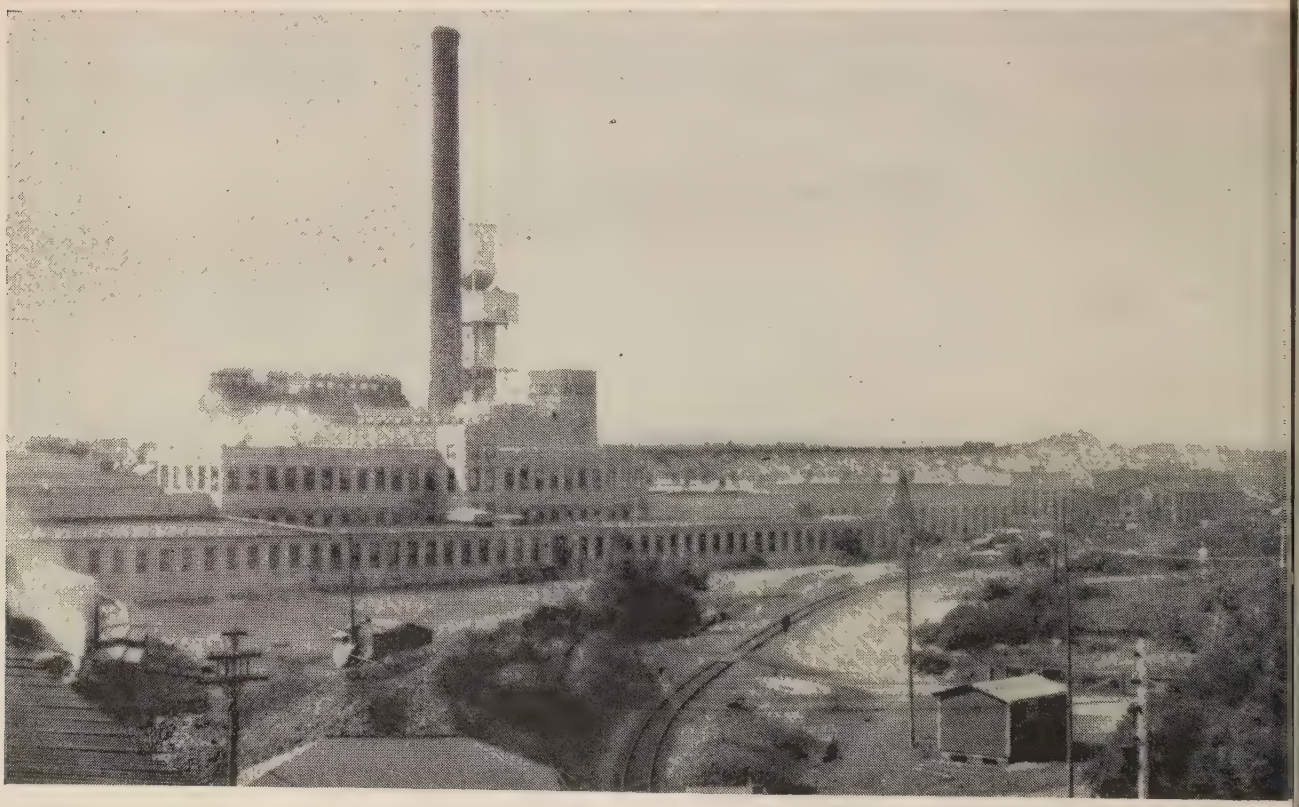
Reorganizations were as follows:

Spanish River Paper Mills Ltd., absorbed Ontario Pul Paper Co.
Wm. Barber & Bros. and the Canada Coating Mills merged to form Barber Paper & Coating Mills Ltd., w then became the Toronto Paper Manufacturing Co.
St. Lawrence Paper Co. at Mille Roches took over Mont Paper Co. at Thorold, Ont.
Rolland Paper Co. acquired the Northern Paper Mills, Adele, Que.
Howard Smith Paper Mills Ltd. was formed.
British Columbia Wood Pulp & Paper Co., Howe Sou B. C., was reorganized by Lester W. David as Colo Lumber & Paper Mills Ltd.
The Crabtree & Sons Mill at Crabtree Mills, Que., bur down with the loss of the watchman's life. Rebuild was begun promptly, as demand was high.

During 1912 the *Pulp and Paper Magazine of Canada* sold to the Industrial and Educational Press, Ltd., and p lication was to be stepped up to twice a month.

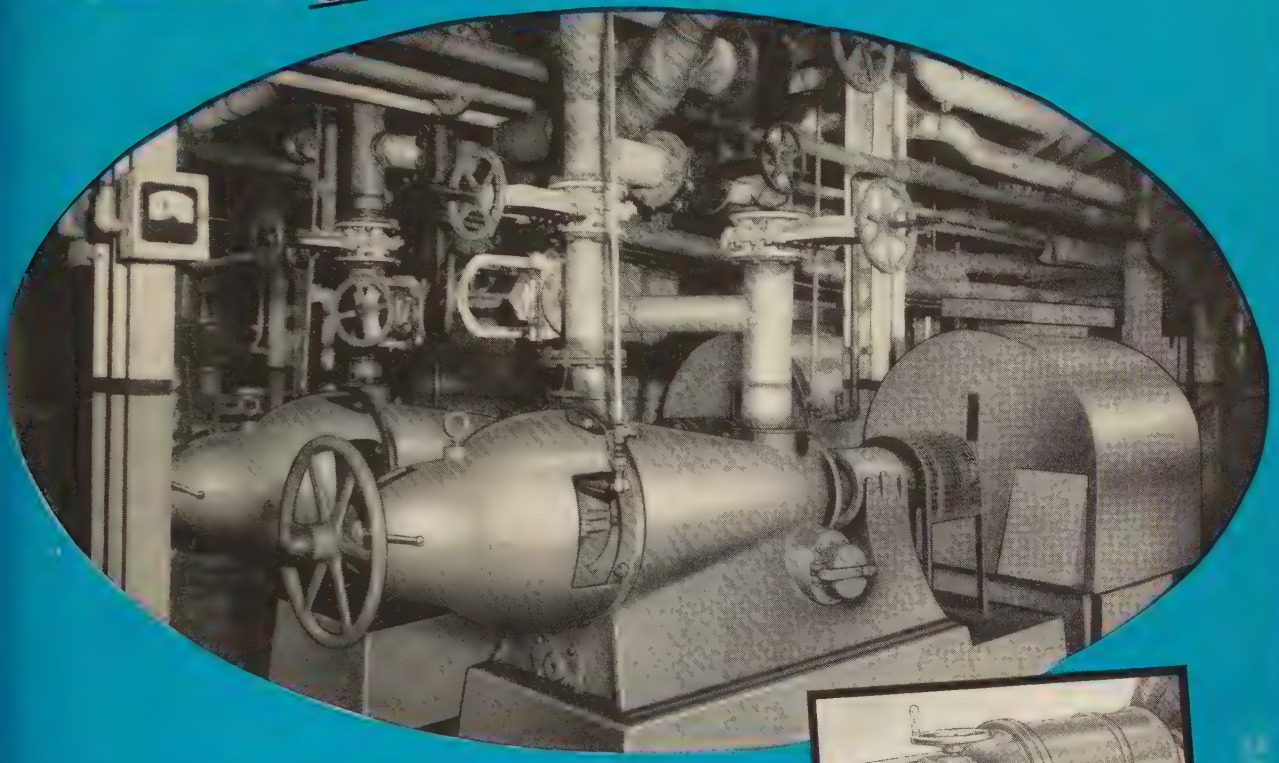
1913

The issue of Jan. 1, 1913, marked a new era in the deve ment of the *Pulp and Paper Magazine of Canada.* The dustrial and Educational Press of Toronto, under the lea ship of J. J. Harpell, became the publishers, and the for was changed to $8^1/_2$ by 11 in. and the magazine made its pearance twice a month. Division of the magazine into partments overcame the previous somewhat haphazard rangement of editorial material. The editor was A. Go



Anglo-Newfoundland Development Co. mill at Grand Falls

ANOTHER E.D. Jones INSTALLATION



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Cornwall Paper Mfg. Co. at Mille Roches, now part of Provincial Paper Ltd.

McIntyre, who later in the year also took over the direction of the newly organized Dominion Forest Products Laboratory at Montreal. With longer and more complex technical articles and many more illustrations, including gatefolds, the magazine began to have a really grown-up appearance. Articles of interest were, "Quebec Forestry" by Ellwood Wilson, "Talc in Canada" by T. Lindsey Crossley, and "Preservation of Paper" by John Norris, who laid aside his cudgels for the ANPA long enough to give forth with something constructive on the subject of permanent records.

The year 1913 seems to have been notable mainly for the continuation of the discussion of the tariff question, which was stabilized at duty free admission of newsprint and pulp by the United States and restrictions by Canada against the export of pulpwood from Crown lands.

The following personal notes will probably bring back memories.

William Whyte, local manager of East Canada Pulp & Paper Co., has left Murray Bay, Que., to become superintendent of the new Abitibi mill at Iroquois, Falls Ont., which is to manufacture groundwood with an estimated capacity of 100 tons. The East Canada Pulp & Paper Co. is to be liquidated.

S. J. B. Rolland became the new president of the Rolland Paper Co., replacing the late Senator Rolland.

R. O. Sweezey, formerly a forestry consultant in Quebec City, became general manager of Montreal Engineering Co.

Edward Flynn, former assistant manager of Jonquiere Pulp Co., rejoins Price Brothers and Co. Ltd. after a shake-up which resulted in the resignation of O. A. Porritts, one of the organizers of the Price-Porritts mill at Rimouski.

J. R. Booth, while supervising the razing of his timber mill, was struck by a falling plank, receiving a broken leg and other injuries. Although 87 years old, he made an excellent recovery. Earlier in the year he had a narrow escape when a coffer-dam collapsed, sweeping seven others into the river and drowning one of them.

The St. Maurice Fire Protective Association elected J. M. Dalton of the Grés Falls Co. as president, S. L. de-Carteret of La Tuque as vice-president, and Henry Sorgius, manager.

On March 19, 1913, the Canadian Pulp and Paper Association was organized, with Carl Riordon as president, W. P. Gundy of the Kinleith Mills as vice-president, and A. Gordon McIntyre, editor of *Pulp and Paper Magazine of Canada*, as secretary-treasurer.

Lord Northcliffe offered a prize in the London *Daily Mail* of £10,000 to the first person making a transatlantic flight in a water plane for 75 continuous hours between any point in this hemisphere and any point in Great Britain, either way.

Hourly wage rates in the paper mills for an 8-hr. day were: machine tender, $4.00; back tender, $3.00; third hand, $2.00; fourth hand, $1.75; fifth hand, $1.50. In May of that year J. R. Booth led the way to increased rates by granting a 30¢ an hour raise to papermakers.

The *Toronto Globe* said, "It is to be hoped that the papermakers of Canada will suspend for a time the fascinating pastime of issuing securities and stick to papermaking."

A carload of paper from Kenogami, on being opened on the Montreal yards of the C.N.R. four days after leaving the mill, was found to contain the body of a man stretched out inside of one of the big rolls. He had eaten a quantity of the paper in an effort to keep himself alive.

Fires took varying tolls at Dryden Timber & Power Co., Ontario, delaying the opening of the mill, Riordon Pape at Merritton, Ont., and the Nova Scotia Wood Pulp & Paper Co. at Bridgewater. The explosion of a pulp digester at the Laurentide mill killed four men and caused damage in excess of $100,000. Price Brothers & Co., Ltd., got their Kenogami mill into regular production, as did the Howard Smith mill at Beauharnois, where the old Dominion Woolen Co. mill was taken over. The Ontario Paper Co. at Thorold came into being, supplied by wood from Anticosti Island, which was being extensively logged by its owner, Henri Menier, the chocolate king, who died later in the year. The Belgian Board Co. also started a mill in Thorold and one near Ottawa. The Spanish River Pulp & Paper Mills Co. absorbed the Lake Superior Corp. The Ocean Falls Co. in British Columbia ran into financial difficulties, as did Western Paper Mills Ltd. of Vancouver.

1914

The year 1914 saw a continued development in the technical side of the industry, with the publication of a numb

Montrose Paper Co. at Thorold, Ont., which was taken over by St. Lawr Paper Co. and now is one of the mills of Provincial Paper Ltd.

Improved Design Features of B&W Recovery Unit assure . . .

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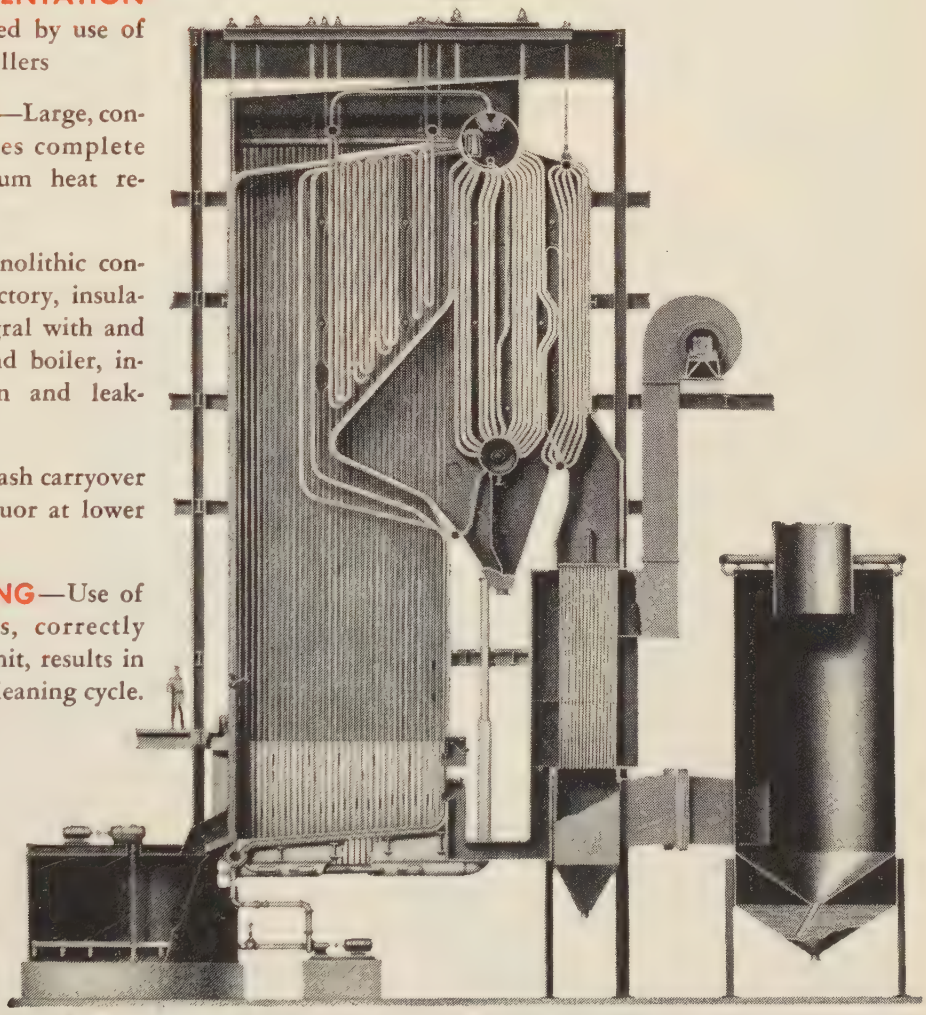
- **CLEAN BOILER**—Low ash carryover is the result of firing liquor at lower per cent solids
- **NO ROUTINE LANCING**—Use of improved soot blowers, correctly located in the recovery unit, results in a thorough and efficient cleaning cycle.



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New York 17, N. Y.

papers in the *Pulp and Paper Magazine of Canada* of considerable complexity which demonstrated the amount of research which had been done on them. Among others John S. Bates wrote on a 2-year research program on the use of southern resinous woods for pulp. At the time Mr. Bates was working for Arthur D. Little. John Stadler wrote on the power requirements in manufacturing pulp and newspaper. (Incidentally, late in 1914 the term "newsprint" made its appearance in this magazine.) T. Linsey Crossley contributed an article on "Technical Education in Papermaking," and Ed. J. Trimbey, M.E., efficiency engineer at Canada Paper Co., discussed, "The Drying of Paper." The "Safety First" movement began to receive some printed recognition, an article in the Feb. 1, 1914 number being the forerunner of this magazine's long-time interest in this phase of the industry. A number of guards were pictured, with their costs appended, some of which ran as high as $15. Objections to compensation legislature were noted, namely, the payment to an employee of 55% of his wages while disabled, and the granting of any awards for permanent disabilities. Among the patents noted was one to Samuel M. Langston of Camden, N. J., for a high-speed winder.

The CPPA held its first convention at the Windsor Hotel in Montreal, and, later in the year, it issued an appeal for statistical data and set up a subcommittee for the purpose of handling it, under the chairmanship of Carl Riordon. R. L. Campbell, editor of the Canadian magazine, became secretary-treasurer of the association. His predecessor as editor, A. G. McIntyre, had become manager of the Bathurst mills, to which were to be added a sulphite and board mill.

War Declared

The issue dated Aug. 1, 1914, contained an editorial about the war which had just broken out in Europe, a war which had a profound influence on the industry and its personnel. That first editorial estimated that newspaper circulation, hence the demand for newsprint, would increase, but that the annual shipments of 350,000 tons of pulp from Europe, mostly sulphite, would cease, with insufficient capacity on this side of the water to make up for the loss. Various experts concurred that the war would last about 7 months. H. Biermans of the Belgo mill was caught behind the German advance and was able to give some vivid descriptions of the desolation in Brussels and Louvain.

At home a government dam near Temiskaming wen causing considerable destruction downstream and result a lack of water later in the Spring which forced a num partial shutdowns. J. R. Booth kept part of his mill go using his steam-engine standbys. A fire burned 10,00 of pulp at the Grés Falls mill (Union Bag Co.), at Cap Madeleine, Que.

New Mills Start Up

Plants beginning operations in 1914 included Hir Dauch in Toronto and Ontario-Minnesota at Fort Fr Ont., with two 186-in. Bagley and Sewall machines ru at 700 ft. Inland Pulp & Paper Co. took over Colonial Products Co. in Thorold, Donohue Brothers bought the ern Canada Pulp Co. at Murray Bay, Ocean Falls P Paper Co. became Pacific Mills Ltd., and St. Lawrence I Lumber Corp. in Chandler, Que., was reorganized. A ing was held in London, England, of the first mortgage holders of the Spanish River enterprises to try to resolv financial problems. C. H. L. Jones, former manager Lake Superior Paper Co., had earlier in the year bee pointed assistant to W. E. Stewart, president of the con Provincial Paper Mills Co. Ltd. was formed by the amal tion of St. Lawrence Paper Mills Co. at Mille Roche Thorold and the Barber Paper and Coating Mills L Georgetown, all in Ontario. John Breakey of Quebec B the Cahaudiere Lumber Co., including 15,000 acres of ti land, for about $350,000. Major improvements were m power development at the Laurentide mill. The Canadian mills at Shawinigan Falls, Que., and those Dryden Timber & Power Co. at Dryden, Ont., unde major improvement programs. A unique reinforced co chute was built at Buckingham, Que., by the MacLar terests, to handle up to 50,000 logs in a 10-hr. period, to them to by-pass the power dam. The Laurentide C nounced a tree-planting program which was eventua tended to cover a square mile annually with 600,000 t 000 trees. They also imported reindeer from Dr. Gre herd to replace sled dogs in their winter bush operations

1915

The article by T. Linsey Crossley on "Technical Educ in the last issue of 1914 brought in a number of letters with the editor's comment on the Report of the Royal

Quebec & St. Maurice Industrial Co. mill at La Tuque, Que., a modern view of what is now the Brown Corp. m

How YOU can profit by OUR experience

Over the years, we have noticed that mills with complete color lines can usually keep paper-making machines operating profitably when adequate tonnage on more competitive lines is hard to get. We have helped many of these mills to get started on colored paper and board specialties.

NATIONAL PAPER DYES

Running colored lines now involves fewer difficulties than you may suspect. With the proper formulas and methods, they can be quite profitable indeed. From first hand experience, National Aniline paper technicians well understand the aspects of making colored lines. They can provide very practical help on formulas and application methods. This is part of our comprehensive service to paper mills. We invite you to use it.

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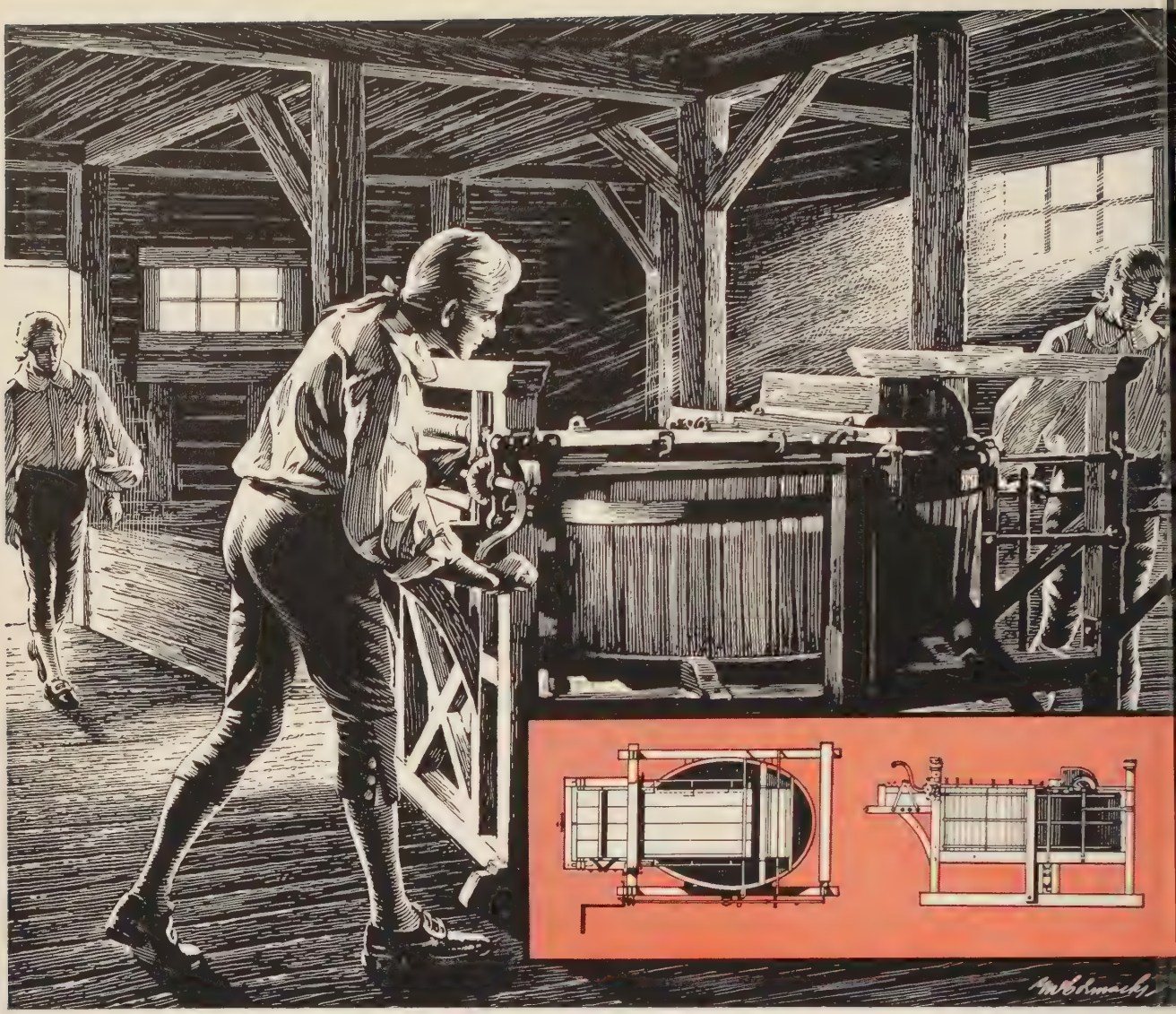

Papermaking Went Into High Gear With This Machine in 1798 . . .

An important event in the history of papermaking was Nicholas-Louis Robert's invention of the paper machine over a century and a half ago. No longer would the slow methods of forming paper by hand limit size and quantity of paper sheets. Robert's machine formed paper of continuous length upon an endless woven-wire cloth which retained the matted fibers. Today more complex machines, operating on the same principle, produce a tremendous volume of paper. Helping maintain its quality are high-grade raw materials produced by A. E. Staley Manufacturing Company, supplier to leading mills for more than 30 years. Discover the many advantages Staley can offer *you*. See your supplier or write for details today.

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Staley Sizing Starches
A full range of starches and dextrins for beater, surface and calender sizing.

Staley Corrugating and Laminating Adhesives
Corrugating starches, special laminating and bag adhesives.

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Starches and Dextrins give better results for machine or regular brush coating.

Staley Plasticizers
"Sweetose"® and Staley's corn syrup are ideal softening agents for glassine paper.

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A. E. Staley Mfg. Company, Decatur, Ill.

NOW Commercial 65% Yield News Sulphite is Here!

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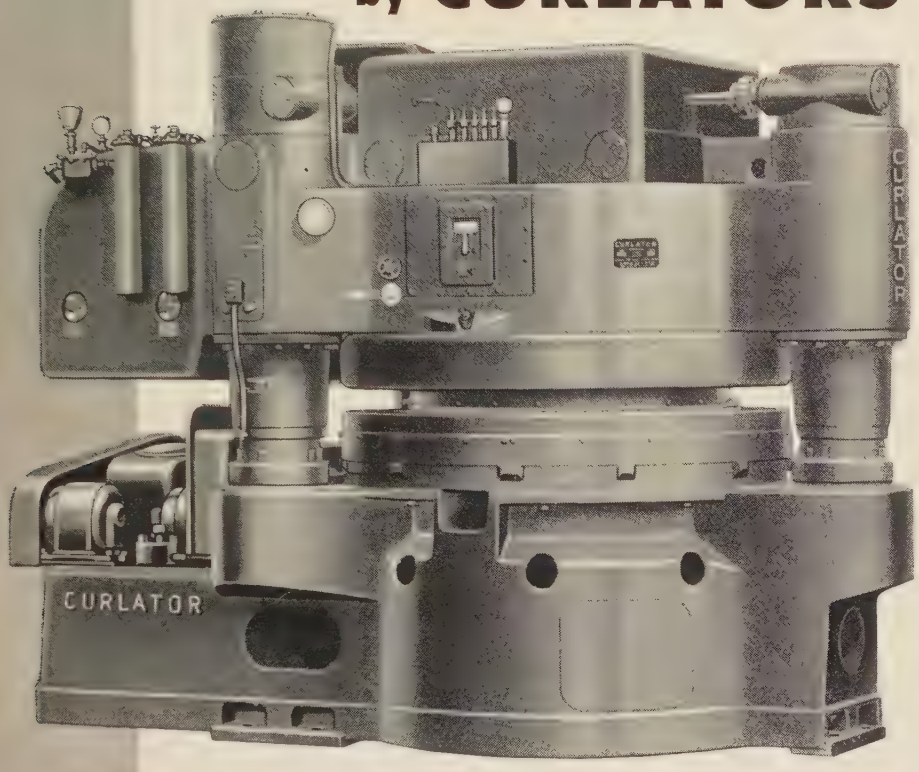

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65% YIELD OF NO. 1 SULPHITE FOR NEWSPRINT

UP TO 30% SAVING IN WOOD ALONE *PLUS* UP TO 30% SAVING IN SULPHUR, LIMESTONE AND STEAM

43% INCREASE IN DIGESTER CAPACITY

WRITE for News Bulletin on Commercial 65% yield News Sulphite.

CURLATOR

The Curlator is the first and only machine to produce a first-class news sulphite pulp at 65 per cent yield in full scale commercial operation.

This "semi-sulphite" replaces normal low yield sulphite pulp pound for pound in the newsprint furnish.

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mission on Industrial Training and Technical Education, indicated a very considerable interest in such matters.

The Laurentide Co. added to its board of directors Sir Thomas Skinner, a director of Canadian Pacific Railway and a governor of Hudson's Bay Co. An issue of Laurentide bonds was expected to notice obligations and to provide for completion of development work under way at Grand'Mere when the war broke out. It was also noted that J. O. Mason was given charge of the production of groundwood, sulphite, and newsprint.

Notice the assessment by the Ontario Workmen's Compensation Commission gave rates of 2.5% of payroll for construction workers; 2% for lumberjacks; 1.8% for sawmill workers; 1.5% for blacksmiths and machinists; 1.4% for pulp and paper mill hands, and so on.

A lawsuit between Barber-Ellis and the Neostyle Envelope Co. involved a license to the former of a license to manufacture a penny postage envelope. The Post Office authorities ruled that it required letter rate postage.

The beneficence of John R. Booth was shown in the announcement that he officially opened a new wing at St. Luke's Hospital in Ottawa, which he had built at a cost of $125,000. H.R.H. the Duke of Connaught presided at the ceremony.

The beginning in 1876 of the well-known firm of Barber-Ellis is told in an interesting biographical sketch of John F. Ellis, partner with John R. Barber in the firm. Mr. Ellis enjoyed relating his presentation to King Edward VII and how pleasantly His Majesty responded to hearing that they shared November 9 as their birthday. Mr. Barber was one of the founders of the Toronto Paper Manufacturing Co. (now Howard Smith Paper Mills' Cornwall Division) about 1880. A disastrous fire in 1904 destroyed the Barber-Ellis warehouse in Toronto and their records were destroyed. But people are honest, and only two of their debtors failed to acknowledge their accounts.

The Canadian Pacific Mills Ltd. having taken over the Ocean Falls Co. at Ocean Falls, B. C., announced that a paper mill would be built.

Newsprint in rolls was quoted at $40 to $43 per ton; newsgrade sulphite, $41 to $42; bleached $54 to $59; kraft, $72 to $80; groundwood, $15 to $16.

Fire seriously destroyed part of Thorold (Ont.) Pulp Co., Dec. 15, 1914. The two grinders and three wet machines were not seriously damaged. The sheet iron siding of the mill prevented the fire from spreading to two adjoining plants.

Big things cast long shadows and small things often catch up with large promises. Two projects that began modestly in 1915 have become of great importance. The announcement that the new Ontario Workmen's Compensation Act provided for an organization of safety associations to promote the work of accident prevention prompted the Canadian Pulp and Paper Association to invite all mills in the Dominion to convene during the convention for consideration of this matter.

Organization of Technical Section

Another move of great moment was the appointment of John S. Bates, superintendent of the Dominion Forest ucts Laboratories, to head a committee charged wit organization of a Technical Section of CPPA. The com met in Ottawa on February 12, as related by Mr. Bates May issue. About half of the charter members have on, and about half of those remaining are still active terested in the work of this section.

Pulpwood producers of today would be amazed situation less than 40 years ago. In the Cochrane distri price of wood was $3.75 a cord. Cost of handling if a had no team was $1.20, loading on car $0.25, freight to rane $0.45. That left $1.85, of which $1.50 was the p labor for cutting, leaving on $0.35 a cord to the settler. that, however, was better for the country than burnin forest. But many settlers rejoiced at having a fire clea land so long as their shack escaped the flames.

Memories of James and other Beveridges are revived notice that the New Brunswick Pulp & Paper Co. at Mil —first paper mill in the province—burned. The loss w timated at $150,000, quite well covered by insurance. Ja Brooks and Norman Beveridge were closely identified wi Dryden Paper Co.

W. H. Rowley, president of the E. B. Eddy Co. die dently in Toronto. He joined the company in 1887 an ceeded E. B. Eddy as president, sharing the general ma ship with George Millen. Mr. Millen was appointed dent soon after.

A news item describes the new building at the Univers Maine, housing the mill equipment and lecture rooms first American school of pulp and paper technology. The ent editor-in-chief of the *Pulp and Paper Magazine of C* J. N. Stephenson, was then on the University of Maine fa in charge of papermaking courses.

At a conference held in Ottawa on January 19 and 20, the auspices of the Federal Commission on Conservatio situation regarding Canada's forest resources and the ne adequate conservation measures was plainly described. as even now, the public was not properly alert to the sit nor aware of its importance. H. R. MacMillan, chief fo for British Columbia and now head of MacMillan & B Ltd., gave an exhaustive survey for forest conditions Canada. He made a strong appeal for better fire protect

The issue of Feb. 15, 1915, describes the new plant of t Lawrence Pulp & Lumber Corp. at the new town of Cha Que. The mill was rated to produce 100 to 110 tons phite per day. Gustave Hansen was pulp mill superin ent, E. J. Dallaire, sawmill superintendent, and F. E. pion, woods superintendent.

Brompton Pulp & Paper Co. started their newsprint m East Angus at the turn of the year, only 9 months after of construction.

One or more representatives of 19 mills attended the s annual meeting of the Canadian Pulp and Paper Associ There were 45 in attendance. The association had 34 pany members and represented about 75% of Canada's and paper tonnage. Roy Campbell, editor of *Pulp & Magazine* was also secretary of the Association. Carl Ri

The Kenogami mill of Price Bros. & Co. Ltd.

Water Economy with
EMERSON SHOWER PIPES

With the Emerson Shower Pipe you can re-use processed water containing solids, thereby cutting water costs with proper cleaning action. The Emerson is equally adaptable for use with fresh water assuring maximum cleaning with minimum water consumption.

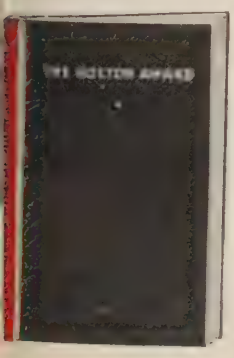
Here are the exclusive features of the Emerson Shower Pipe:

An ingenious mechanical nozzle-cleaning device (individual stainless steel replaceable brushes) which automatically keeps openings free of foreign matter.

When brushes are in the openings of the nozzles an internal flush valve synchronized with the movement of the brushes opens to flush out the pipe from end to end. When the brushes pass the openings the valve closes.

Replaceable nozzles of stainless steel, ni-tralloy or carballoy to meet all conditions.

Custom-made for specific mill uses in pipe sizes of 1½", 2", 2½", 3" and 4". The Emerson Shower Pipe is recommended for use on Fourdrinier wires, felts, cylinder molds, rotary screens, thickeners, washers, grinding stones, wet machines, for foam killing and humidifying, and for special applications.



Call or write for further information about Emerson Shower Pipes.

The Emerson Manufacturing Co.

Division of John W. BOLTON & Sons, Inc.

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was president and the meeting elected I. H. Weldon to succeed him. Addresses were given by R. F. Stupart, W. P. Gundy, W. J. Roche, and R. H. Campbell. The constitution was amended to make the Technical Section a part of the Association.

The Technical Section held its first meeting concurrently with that of the CPPA. Officers elected were: chairman, J. S. Bates; vice-chairman, T. L. Crossley; councillors, C. B. Thorne, Dan Daverin, and G. W. Dickson. J. J. Harpell, publisher, and Roy Campbell, editor of *Pulp & Paper Magazine*, took an active part in the meeting. Papers were contributed by C. B. Thorne, J. W. Robertson, G. W. Dickson, J. A. De Cew, R. H. Campbell, O. F. Bryant, Dan Daverin, and Einar Gelertson.

On March 5, the Council of the Technical Section met at the Forest Products Laboratories and drew up a tentative constitution. The council also voted "That until the next general meeting of the section, the *Pulp and Paper Magazine of Canada* shall be considered the official journal of the Technical Section." It still is.

Freight Rate Increase

An important freight rate situation developed when the Grand Trunk Lines applied for substantial increases in their tariffs on paper, wood pulp, and pulpwood. A. D. Huff appeared before the Board of Railway Commissioners with strong arguments supported by facts showing the unfairness of such increases and their harmful effects on this industry. The editor pointed out that contrary to their showing causes for making increases, the hearing put the public on the spot to show why the railway should not do so. Average rates in Canada were shown to be materially higher than those in the United States.

The 50-ton sulphite plant at the J. R. Booth mill started operation about the 1st of May. This enabled the company to make all of its pulp requirements.

The Commission of Conservation reported good progress in the organization of cooperative forest fire protection. The Lower Ottawa and the St. Maurice Forest Protective Associations showed good results for 1914 and a new organization, the Upper Ottawa Forest Protective Association was to be formed. The two operating associations patrolled over 24,000 sq. mi.

Perhaps the successful formation of the Technical Section of the Canadian Pulp and Paper Association at their annual meeting in February started a similar movement in the United States. A group of 35 technical men met during the American Paper and Pulp Association convention and appointed an organizing committee of five. A preliminary meeting was held on April 6 in Chicago with Harry E. Fletcher as chairman and W. G. McNaughton as secretary, and a constitution was tentatively adopted. A second meeting was held in Chicago on May 6, with Frank L. Moore, president of the American Paper and Pulp Association in the chair. A constitution was adopted which named the new organization the Technical Section of the American Paper and Pulp Association. Mr. Fletcher was elected chairman of the Executive Committee, with Mr. McNaughton and Ernst Mahler as Associates. T. J. Keenan, editor of *Paper*, was chosen secretary-treasurer, and *Paper* was designated as the official journal of the section.

The paper companies of Ontario got a blast from t tor's pen for not showing up in force at a meeting of t tario Pulp and Paper Makers' Safety Association. The men's Compensation Board had assessed each company rate of 1.4% of its total pay roll for an accident ind fund. It was assumed that the possibility of reduci cidents costs by cooperative action would be a matter o interest and concern to the manufacturers.

From the very beginning the Technical Section, CP held a succession of successful Summer meetings whic been an important factor in the solidity of the organ and the value of its accomplishments. About 40 memb tended the first of these which was held in Montreal, J 1915, when technical papers of a high order were presen John S. Bates, H. N. Lee, and H. S. Taylor.

An "Honor Roll" of 67 members of the pulp and pa dustry who had enlisted for overseas service was publis the issue of July 15, 1915. It listed C. H. Daw Abitibi Power & Paper Co. and R. Amy, Jr. of Price B Co. as killed in action, E. C. Culling and H. D. Powell o Bros. as missing in action. The roll grew longer, mo month, and reached 132 by August 15. Col. Wm. Pric C. H. L. Jones, and Col. J. B. White have been specially in recruiting.

Geo. R. Copping, president of Barber Paper & C Mills and director of Provincial Paper Mills Co. and hi were victims of the *Lusitania* disaster.

Newsprint started to roll off the machines of Abitibi & Paper Co. at Iroquois Falls in July.

Editor Campbell Joins CMA

An announcement in the September 1 issue by J. J. H president of the Industrial and Educational Press, state both regret and pride that Editor Campbell had accep position of secretary of the Montreal Branch of the Ca Pulp and Paper Association. John (Jack) Ross became *pro tem.*

Probably for the first time, an aviator was emplo Wisconsin to detect forest fires.

George Cahoon, Jr. became president of the La Co. in October 1915, C. R. Hosmer was made vice-p

St. Lawrence Paper Mills at Mill Roches, Que., which was amalgamate the Montrose mill at Thorold, Ont. by Provincial Paper Ltd.

For makers of Quality Papers

ASTRACEL

BLEACHED HARDWOOD SULPHATE

Bleached With

CHLORINE DIOXIDE

This is a perfected bleached hardwood sulphate . . . made from carefully selected species of southern hardwood trees which yield the longest and finest hardwood fibre available. Astracel has the excellent forming qualities found in northern hardwoods . . . *plus great strength.* It is produced at Riegel Carolina's new pulp mill at Riegelwood, N. C., with every refinement and control known to modern pulp manufacture.

Riegel Carolina Pulps

ALBACEL • SUPER ALBACEL • ASTRACEL

Created by Papermakers

for Papermakers

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and W. F. Robinson, secretary. The first of six 20,000-hp. units in the new power house was started the same month.

The dyestuff situation had become serious and some colors were unobtainable. There was evidence in both Canada and the United States of establishing a dyestuff industry independent of European supplies.

A. G. McIntyre must have been proud to see in the November 15 issue of the magazine of which he had been editor, the article describing the pulp and board mill of Bathurst Lumber Co., of which department he had become manager. Associated with him were J. H. Thickens, A. A. MacDiarmid, A. G. Hinzke, and J. G. Mayo. The mill was then making strong unbleached sulphite and a strong container board made by a process akin to semichemical pulping. The chips were steamed with a small percentage of caustic, blown and treated in kollergangs, and refined in stone-roll beaters.

The Fall Meeting of the Technical Section, CPPA was held at Montreal on November 19, with a very good attendance. Delegates came from Sault Ste. Marie and Washington, D. C. Reports were made by the committees on technical education, collection of samples; standards and testing methods, and literature and statistics. B. Johnson read a paper on "Chemical Analysis of Wood Pulps," and J. A. De Cew on "Paper Making Supplies."

The Forest Products Laboratories of Canada were formally opened on Dec. 3, 1915, by W. J. Roche, Minister of the Interior. Some 45 men of prominence, in government, education and industry, were received by Sir William Peterson, principal of McGill and conducted around the two buildings. Actual work has been going on for quite some time and the total staff numbered 30, seven of whom were on active service.

1916

Enlistments in the armed forces had reached 438 by the first of the year.

A. G. Pounsford was appointed safety engineer of the Ontario Pulp and Paper Maker's Safety Association. This began a long and distinguished career in this industry.

Laurentide Co. under the direction of Ellwood Wilson, were demonstrating the value and feasibility of raising their wood supply in the backyard, as it were. They planted 10,000 trees in 1912 and in 1913, 145,000 in 1914, 210 000 in 1915 and expected to be planting a million a year. Mr. Wilson anticipated a cut per acre of ten times that in natural forest and to get better timber. Interference of hardwood bush was overcome by grazing the company's reindeer on the plantation.

Sweden Embargoes Pulp to Britain

Sweden placed an embargo on chemical wood pulp to Britain apparently in retaliation for interference with her shipment of iron ore and food to Germany. It was expected that Canada and the United States could easily make good on this supply. According to the Swedish Board of Trade the action was caused by shortage of chemicals and was not absolute.

A Forestry and Conservation Congress was held in Ottawa in January. The report of Clyde Leavitt chief forester of the Commission on Conservation included recommendations for urgent attention to such matters as: reorganization of fire-ranging cooperative forest protection, slash disposal and permit system, forest survey, and inventory of resources.

The third annual meeting of the Canadian Pulp and Paper Association gave proof of its value and vigor. President I. H. Weldon reported on the activities of the association and reports of the various sections were presented. J. H. A. Acer was elected president, and C. Howard Smith, vice-president. The luncheon was addressed by Frank L. Moore, president of the American Paper and Pulp Association. During the afternoon, delegates visited the Forest Products Laboratories, where the experimental mill was in operation. The Technical Section also met, under the chairmanship of John S. Bates. It was a well-attended and very enthusiastic meeting, with excellent papers and lively discussion. Mr. Bates was re-e chairman and C. B. Thorne was elected vice-chairman.

George H. Mead was elected president of Spanish Pulp & Paper Co.

U. S. Secretary of Commerce Redfield held a conf with paper manufacturers on the shortage of some pape ing materials. It was determined that the Forest Pro Laboratory should extend the study of pulpwoods an the Bureau of Standards should look for a substitute f ported English clay. The Department of Commerce u took to publicize the need for saving rags and waste An extreme instance of the effect of the war on prices o terials was the statement that aniline colors had adv from 20 cents to 20 dollars a lb.

The magazine's roll of enlistment from the industry re upwards of 600 at April 1, 1916.

An important move, prophetic of the good relations have grown up with the American and Canadian Pul Paper Associations, was the appointment by both of mittees to consider jointly the situation created by a sh of fourdrinier wire. President Acer of the CPPA and dent Daniels of APPA were warmly commended for the tion in this matter.

Writing Manufacturers Consider Standardization

A meeting of the American Writing Manufacturers' ciation gave serious consideration to a plan for standardiz of sizes and weights and colors so as to eliminate the loss wastage on short runs, overruns, trouble in matching Adoption of British sizes was favored because of their w wide acceptance in export trade. Of considerable interes was the matter of watermarks and the advantage o marks rather than a multitude of private marks.

The American Paper and Pulp Association conside campaign to formulate a standard method of cost acco to correct haphazard and inaccurate methods whose erro results have caused market disturbances and loss to ma turers.

Roy Campbell, former editor of *Pulp & Paper Ma* then secretary of the Canadian Pulp and Paper Asso and of the Montreal Branch of the Canadian Manufa Association, was chosen as secretary of the trade comm to go overseas and investigate trade prospects with the Nations.

In the June 1 issue is a list prepared by the Dom Forestry Branch of the active pulp and paper mills in Ca Of the 48 mills, 22 were in Quebec, 15 in Ontario, 5 in Scotia, 4 in New Brunswick, and 2 in British Columbia.

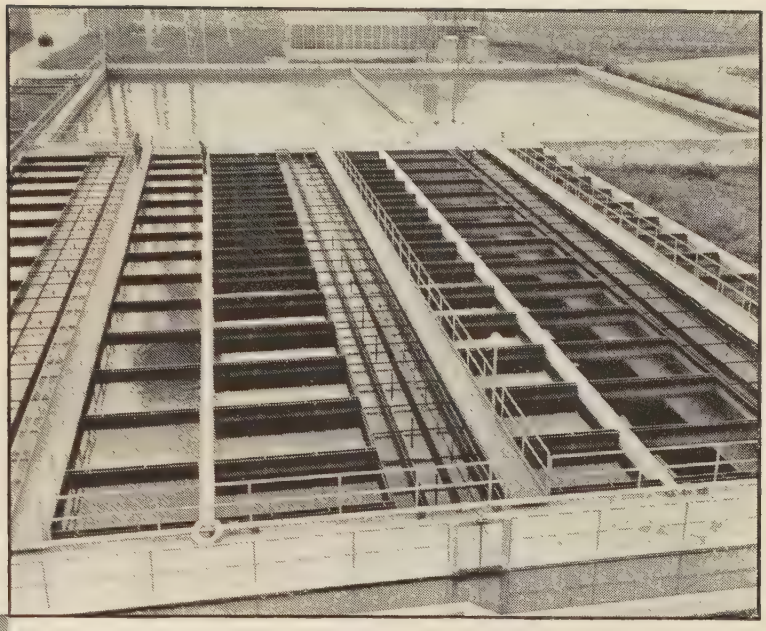
The Red Cross Society, of Toronto, expected to make $25,000 from collection of rags and wastepaper. Two volunteered to drive trucks, replacing male drivers gone Front.

Paper Men Lead Regiments Overseas

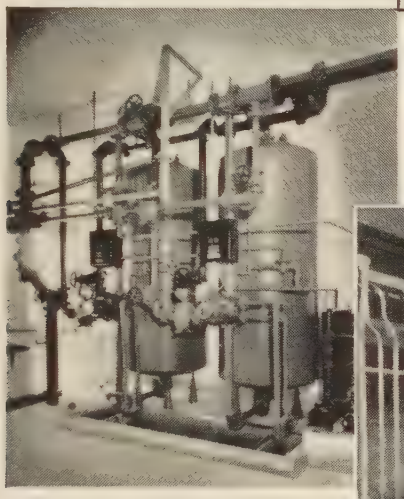
Lt. Col. C. H. L. Jones was given leave of absence f Spanish River Pulp & Paper Co. to command a regime was instrumental in recruiting, and Lt. Col. J. B. Whi recalled from his post with the 224th Overseas to orga Canadian Forestry Battalion. Sir William Price also overseas in command of a battalion recruited largely th his efforts. Another prominent paper man, J. H. A. A the Laurentide Co., and president of the Canadian Pul Paper Association, went overseas with the 244th.

The Technical Section's Summer meeting was an out ing success. Crossing from Toronto to Port Dalhou boat, the delegates visited the Kinleith Paper Mills, ther to the Thorold Carnegie Library for a civic welcome. lunch, the mills of Ontario Paper Co. and Beaver Wood Co. were visited. Dinner was at the Clifton Hotel at N Falls, followed by a business meeting. The next mor visit was made to the Cliff Paper Mills at Niagara Falls,

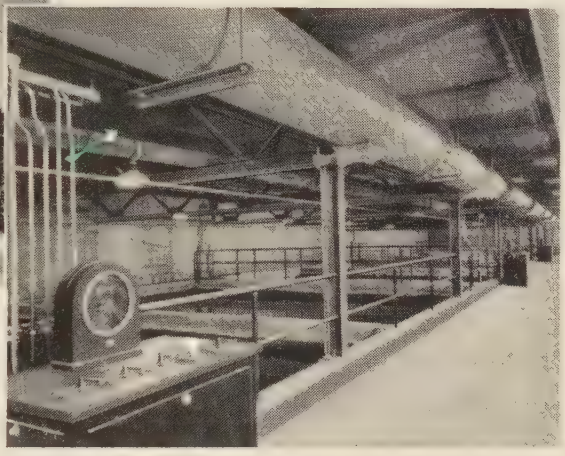
Which process will solve your quality-control problem?



PRECIPITATOR clarifies and softens cold water. Reduces turbidity, color, iron and manganese . . . banishing stains, off-shades, dull products.



ZEOLITE SOFTENERS (Ion Exchange) quickly remove hardness . . . prevent troublesome scale in bleach tanks, boilers. Reduce staining iron, manganese.



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Process water that looks crystal clear can be the cause of your production headaches.

Small amounts of color or suspended matter stain, streak and dull white and colored products. A trace of iron or manganese stains all products . . . even unbleached!

Water hardness forms *scale*. It contaminates pulp in bleaching . . . shortens wire life through frequent souring.

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Permutit Engineers work with a complete range of water conditioning equipment—all types, all sizes. They can recommend the process that best solves your problem . . . pays for itself in higher paper quality at lower cost.

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Water Conditioning Headquarters for Over 40 Years

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and in the afternoon visits were made to Provincial Paper Mills, Interlake Tissue Mills, Riordon Pulp & Paper Co., Lybster Paper Mills, and Lincoln Paper Mills. An evening sail across Lake Ontario brought the party back to Toronto.

Foretelling the blight of inquiries to come, the Federal Trade Commission, in July, sent questionnaires to newspaper publishers with a long list of specific questions on terms of contracts for newsprint. A hearing of publishers was announced for August 1.

Lives Lost in Big Forest Fire

Over 400 lives were lost in the disastrous forest fires that swept over Northern Ontario. The Abitibi Co. lost over 30,000 cords from their block pile and had to hire hundreds of men at high wages to cut more. The fireproof concrete mill proved a haven for many whose homes were threatened.

The property and undertakings of the Mattagami Pulp & Paper Co. were taken over by interests connected with the New York & Pennsylvania Paper Co., with intent to complete the sulphite mill at Smooth Rock Falls and the power plant at Smoky Falls. S. R. Armstrong succeeded A. G. McIntyre as general manager.

The Technical Section's Committee on Standards issued proposed methods of analysis for sulphite of alumina (alum), and rosin and rosin size.

New Mills and Extensions

The activity in extending Canadian pulp and paper capacity was shown in announcements that Canada Paper Co., at Windsor Mills was building a finishing room extension; Provincial Paper Mills would erect a new mill at Mille Roches and install a new 148-in. fourdrinier; excavation had begun by Lincoln Paper Mills at Merritton for a new sulphite mill; British Columbia Sulphite Fibre Co. were commencing to build a mill at Quatsino; Garden City Paper Mills were building a machine room at St. Catharines; Interlake Tissue Mills had completed a three-story addition to the finishing room; Ontario Paper Co. had a new sulphite mill nearly completed; installation of bleaching equipment would enable the Riordon Co. at Merritton to bleach the entire output of sulphite; Abitibi Power & Paper Co. were building an extension to house two 232-in. newsprint machines, the largest in the world; Strathcona Paper Co. announced the purchase of a Harper-type fourdrinier machine; the new board mill of Northumberland Paper & Electric Co. at Campbellford, Ont. was completed; Donnacona Paper Co. announced another news machine.

Reports from many foreign countries indicated a world-wide shortage of paper.

The present editor-in-chief was one of the 53 attending the meeting of the Technical Section, CPPA, November 24 and 25, beginning a long and happy association. Reports of the standing committees showed considerable activity and progress with regard to abstracting of literature, technical education, standard methods, and an advisory committee to the Forest Products Laboratories. Addresses were made by Ellwood Wilson, Roy Campbell, H. O. Keay, A. G. Pounsford, John Stadler, Olivier Rolland, and O. F. Bryant.

A trend of the times was reversed when the Riordon Pulp & Paper Co. acquired controlling interest in the Ticonderoga Pulp & Paper Co., Ticonderoga, N. Y.

It was estimated that Canada's forest fire loss in 1916 was no less than 9 million dollars.

1917

Under the tutelage of Jack Ross of the *Journal of Commerce*, who had been pinch hitting on *Pulp & Paper Magazine*, the new (and present) editor got off his first issue, dated Jan. 4, 1917, which contained a comprehensive, special article by O. F. Bryant on the pulp and paper industry of Canada and a paper by R. B. Wolf on mill efficiency, presented at a mee of the Technical Section.

An Order-in-Council provided that timber and pulpw cut on Dominion lands must be manufactured in Canada.

Plans to proceed with the classification of the Crown L of New Brunswick were announced by Forester P. Z. Ca hill. More efficient and profitable returns from their use anticipated.

A wireless telephone system was installed in the Ur States forest reserves in Southern California. This was first such system in the world.

CPPA President Goes to War

Capt. J. H. A. Acer. president of the Canadian Pul Paper Association being at the Front with his regim Vice-President C. Howard Smith presided at the annual vention. A new assessment in cents per ton was establish provide the $8500 required by the budget for the work dor the Association. Roy Campbell having resigned to join Riordon Co., Arthur L. Dawe was appointed secretary, Smith's address dwelt at some length on questions of fre standardization, cooperation, and tariff. The various sec submitted specific reports. The CPPA elected C. Ho Smith as president and F. H. Anson as vice-president.

Papermakers were urged to find places for the incre number of soldiers returning, and to make positions for t who were handicapped by partial disabilities. Efforts a habilitation were encouraging, and to be encouraged.

An innovation was a joint meeting of the executive mittees of the Technical Section and the Technical Ass tion of the Pulp and Paper Industry, at Erie, Pa., on M 22. Six Canadians attended and several important ma of common interest were discussed—abstracts, stan methods, vocational education. The TAPPI Executive C mittee elected H. P. Carruth as chairman to succeed W MacNaughton, who had joined Inland Empire Paper Co.

Many things acquired a new aspect when the United S declared war on Germany. The effect on the paper situ did not immediately become apparent, but became a f of increasing importance.

The Honor Roll, published in our issue of April 12, listed 1562 men from the Canadian pulp and paper in who served with the Colors, 1914–16. Of these, 67 killed, 87 wounded, 8 missing, 4 were taken prisoners, a others died. Decorations included 3 D.C.M., 4 M.C., a M.M.

A thunderbolt struck the industry in April when a Fe Grand Jury indicted seven newsprint manufacturers for travening the United States antitrust law. One of the a ant district attorneys said the indictment need not be nected with what action the Federal Trade Commission m take with regard to the price of newsprint.

Mabel McClane Brown, publisher of a paper out in Was

The newsprint mill of Price Bros. & Co., Ltd. at Keno Que.

Air-handling specialists for 100 years

Starting in 1854 with the invention of the Rotary Positive Blower by our founder, Francis M. Roots, our company's services to industry were, for many years, devoted exclusively to air-handling problems.

As industry developed new applications of gases for fuels and chemicals, it was a natural step for us to move into this field because the general principles of moving and measuring air and gas are so closely similar.

Thus, Roots-Connersville service has been widened to include seven basic types of equipment for handling gas or air. The most recent development has been the new Spiraxial Compressor, first marketed in 1953.

So, for a century we have been engaged exclusively as specialists in handling gas and air. That is our only business. We like to think that this is one of the important reasons why Roots-Connersville equipment has been so widely accepted and has proved so satisfactory in every industry where processing involves the movement of air or gas.

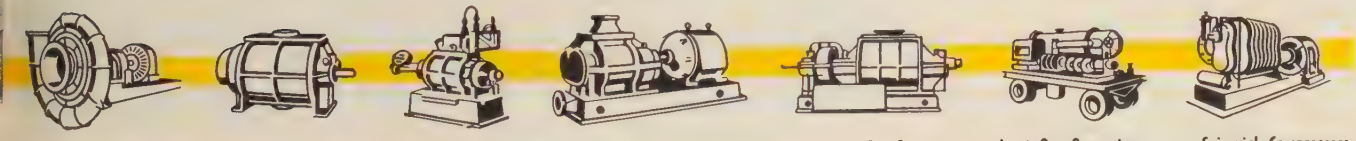
The growth which we have experienced over 100 years could not have been possible without the loyal support of our many thousands of customers. We thank them for this evidence of good will—and we offer the same high type of equipment and service to any industry that has a problem of moving gas or air.

ROOTS-CONNERSVILLE BLOWER

Reg. U.S. Pat. Off.

BLOWER BUILDERS • R.C. • SINCE 1854

A DIVISION OF DRESSER INDUSTRIES, INC.
154 Maple Ave. • Connersville, Indiana



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiraxial Compressors

ton State, undaunted by the shortage or price of paper, put out an edition in which a hundred thousand shingles went through her presses.

An average of 55 attended the industrial classes held two nights a week at the Thorold High School. The success of these classes was largely responsible for the initiation of the textbook project.

The Newsprint Probe

May 8 saw and heard the beginning at the Court House in Ottawa of an investigation of the newsprint industry that was destined to continue for many months. Bitter complaint was made at a later hearing, when it was known that private production costs had been given to publishers.

The first newsprint machine at Pacific Mills Ltd. went into operation early in June, turning out 75 tons a day. A second unit was to be installed this year.

The Summer meeting of the Technical Section CPPA was a great success. The Montreal contingent left June 14 on the night train. From then on they were guests of the St. Maurice Valley paper mills whose generous hospitality was deeply appreciated. The tradition of these Summer meetings was a big factor in the effectiveness of the Technical Section. George Chahoon, president of the Laurentide Co. welcomed the guests to Grand'Mere. Mr. Bates responded on behalf of the Technical Section and H. P. Carruth for TAPPI. High light of the meeting was a well-organized tour of the Laurentide Mill, of which C. B. Thorne remarked: "I appreciate the cleanliness observed everywhere, as well as the good order and the efficient organization. I also notice that anything new is built right. You don't try to save on first cost, but on maintenance."

World Paper Situation

A review of the world's pulp and paper markets showed that conditions were pretty grim overseas. Shortage of raw materials was principally responsible for decreases in production and imports of paper and board were largely reduced. Spain prohibited all exports. Italy had received no cellulose for 2 months and despaired of getting any for a long time. Sweden and Norway suffered for lack of Russian wood. German newspapers explained a terrible disrespect of not publishing a speech of Imperial Secretary Helfferich because journals were compelled to curtail long-winded reports because of lack of paper. In England, the establishment of new newspapers was forbidden; imports of papermaking materials in February were 87% below those of the previous February. The Paper Commission recommended the price of newsprint at 8.1 cents for April and 9.1 was quoted for May, tentatively. France was reported to be in a worse state and the number of pages was limited by agreement between the government and the Press Union.

An interesting feature of the meeting of the Ontario Pulp & Paper Makers' Safety Association meeting at St. Catharines was a tour of some of the mills in that district. A. P. Costigane had become secretary succeeding A. G. Pounsford.

The shortage of freight cars became serious but was partly relieved by a movement to load more tonnage per car. By this means, one American railroad saved 6319 cars in 1 month. The Summer meeting of the Technical Section included a visit to the mills of St. Maurice Paper Co.

The Laurentian Forest Protective Association appointed as manager R. L. Seaborne, who was previously an inspector with the St. Maurice Forest Protective Association.

The high price of paper reached a rather fantastic lim Ottawa when a newspaper cost the dealer $25. He was f for selling it on Sunday.

Editorial and news items continued to stress the effort safety associations and company propaganda in the effo prevent accidents. Education and conversion of worke the key to betterment.

The slogan to help relieve the freight car situation—a load is a car full.

A paper mill, that is no more started operations at Cam East, Ont. The Houpt Paper Mills established there to duce vegetable parchment. It was changed later to proc other grades, but eventually failed.

The embargo imposed on exports from the United State July 9 was intended to stop shipments from reaching en countries. Although an ally, Canada was affected and ex licenses had to be applied for, except that a permanent lic was issued for coal. Even so, coal was scarce.

Operation of the Conscription Bill was thought to port many accidents in industry where experienced men were placed by new hands, unless papermaking were classe an essential industry. Sam Berger, assistant superintend of the soda mill at Canada Paper Co., was an early dra He had been a student of the editor at the University of Ma

The Swedish embargo on pulp shipments to England lifted after being in effect for a year.

Beater men and machine tenders at the Lybster mill wa out on strike to enforce demands for an 8-hr. day and no in take-home pay.

A bill introduced in the United States Congress authori the Government to take over and operate newsprint mills dropped like the proverbial hot potato when the publis came to realize that such action would make the situa only more difficult.

Formation in the United States of the Publishers' Pa Co. was expected to insure supplies of newsprint to s papers not able or willing to protect themselves with tracts. This organization was intended to ease the situatio the small publisher. A pool was created by commandeeri percentage from large consumers.

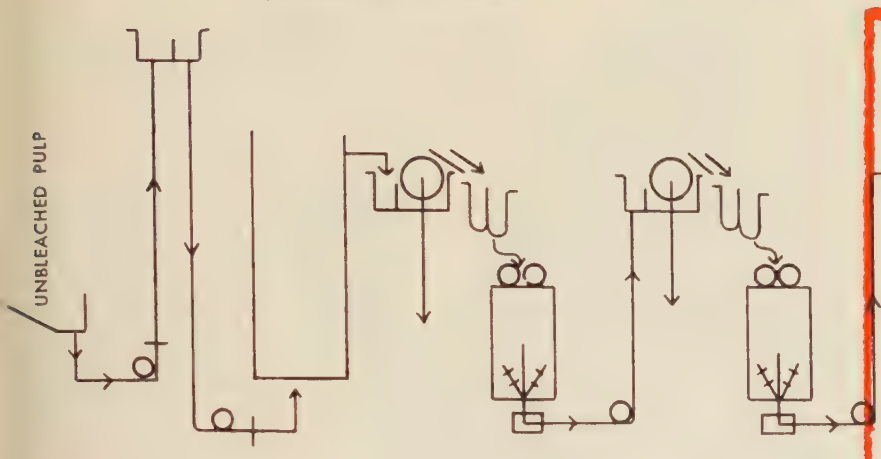
To cope with difficult conditions affecting the expo Canadian newsprint, several manufacturers in Quebec for the Canadian Export Paper Co. George F. Steele, for secretary of the (U. S.) Newsprint Manufacturers' Associa was appointed general manager.

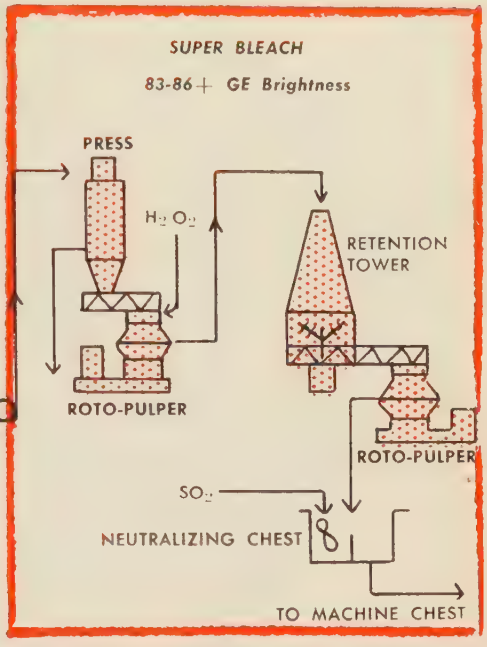
J. J. Harpell, publisher of this magazine and other indust journals, was appointed to the Board of Food Control. C F. W. Wallace, editor of the *Canadian Fisherman* was viser to the Fish Commission and also served as master o anti-submarine "mystery ship."

A very successful joint meeting of the Technical Sec and the Technical Association (U. S.) was held in Septem at Holyoke, with a tour of mills in the Berkshires. Abou Canadians attended. The editor reported on a plan of

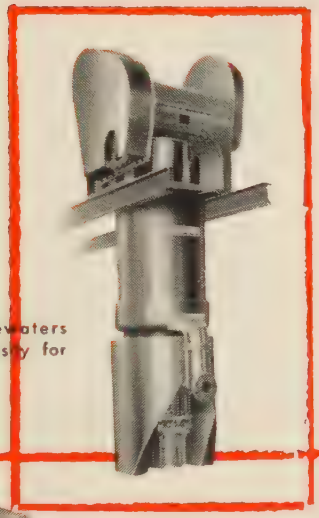
Bathurst Power & Paper Co. plant at Bathurst, N. B.

GET HIGHER BRIGHTNESS





through SUPER bleaching!



Zenith press dewaters pulp to high density for bleach mixing

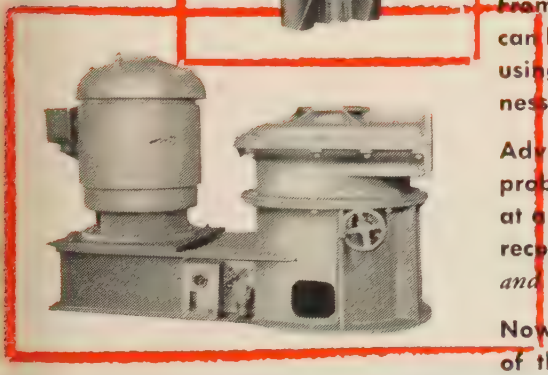
A PREMIUM PULP . . . GREATER PROFITS . . . PLUS THESE ADVANTAGES: ECONOMICAL—lower chemical, steam and power costs. LOW CAPITAL COST—only one extra stage of high density required. SAFE—no damage to pulp physicals . . . yield retained . . . no reversion.

From a semi-bleached pulp with a brightness of 71-73 GE, most pulps can be readily superbleached to 83-85 GE with one extra stage (above) using peroxide at high density. Under favorable conditions brightnesses approaching 90 GE can be obtained.

Advantages of high density bleaching and some of the inherent problems, including difficulty of introducing and distributing bleach at a uniform rate and eliminating nodules or "knots", have long been recognized. *(See "Manufacture of Pulp and Paper", pp 855-6, para. 28 and p 878, para. 51.)*

Now both of these obstacles have been removed with development of the Jackson & Church Roto-Pulper. Three years' plant experience proves conclusively that Roto-pulpers successfully mix bleach in desired quantities on a continuous basis and remove troublesome nodules.

With these problems solved, the industry now can take full advantage of high density bleaching and its inherent features.



015 Roto-Pulper serves as bleach mixer, second Roto-Pulper as a denodulizer.

Our engineers are ready to assist with your paper and pulp processing problems. Write to Zenith Division, Dept. PI.

JACKSON & CHURCH CO. SAGINAW, MICHIGAN

J-C

Work well done since eighty-one

operation to produce abstracts of current literature. The Technical Section Publications Committee later developed a numerical classification system.

The Paper Probes

Most important event in 1917 was doubtless the imposition by Order-in-Council as a war measure of a standard price to Canadian publishers of 2½¢ per lb. for newsprint. A trial period of 3 months from March 1 was set, with the understanding that, if this price could be proved unfair by the manufacturers, a new price would be set. After many hearings and the compilation of many figures by a competent auditor (Geoffrey Clarkson), the reports to Commissioner R. A. Pringle, K.C., of 13 mills showed an average cost of $57.33 for operation during July–December, 1916. Crown Counsel A. H. Stewart gave the amazing opinion that pulpwood had a value of only what it cost the owner in dues to the government —not more than 50¢ per cord. Mr. Pringle thought $2.00 a cord not unreasonable. Result of the inquiry showed that the paper companies lost some half a million dollars by the arbitrary imposition of the 2½¢ price. Commissioner Pringle was appointed Paper Controller. *Pulp and Paper Magazine*'s Ottawa correspondent promptly got in touch with Mr. Pringle and was informed that the publishers would wait on the government. "Meanwhile, the order has been extended for 20 days," said Mr. Pringle. This was on Friday, November 22. It, therefore, came as a rude shock that Mr. Pringle acceded to the publishers' plea for a further extension of 2 months on a flimsy pretense.

Hardly had the newsprint price hearings closed than Controller Pringle held a preliminary sitting in Toronto on November 9 in an inquiry into the price of book papers, asked for by the Canadian Press Association. There was a large representation of both papermakers and publishers of periodicals. The difficulty of ascertaining exact costs for a certain paper was made evident, and Mr. Pringle urged the publishers and papermakers to agree on reasonable prices, rather than precipitate a lengthy and difficult investigation.

Shakespeare would doubtless have had several words for the way the pulp and newsprint probes dragged out in Canada and the United States. Reading the evidence given by the manufacturers one realizes that the papermakers 35 years ago had their troubles to make paper at a profit. The ceiling of $50 a ton for newsprint did not make the task any easier.

Woodlands Section Formed

The Canadian Pulp and Paper Association had a new member added to the family when the Woodlands Section was born on November 23. Conceived as a service division along the lines of the Technical Section, 16 interested persons met in Montreal under the chairmanship of Carl Riordon. After remarks by Ellwood Wilson, A. B. Recknagel, R. H. Campbell, G. C. Piche, Col. J. B. White, and Senator Edwards had been discussed, Ellwood Wilson was named chairman of the new section. An organization committee was appointed, consisting of Mr. Wilson Walter Kernan, and Angus McLean. They proceeded forthwith to prepare a constitution and by-laws.

The Newsprint Service Bureau was formed in New York on December 12. The old Newsprint Manufactu Association had been dissolved.

1918

Price Brothers & Co. were obliged to close their Kenog Mill because of the shortage of freight cars. Several mill Niagara Falls N. Y. were forced to close because their pc was cut off by government order.

Paper Probe Resumed

On resumption of the book paper probe, Controller Pri again urged a rapprochement between periodical publis and papermakers. The auditor believed it almost impos to separate the various classes of paper. Counsel for Riordon Co. declared that, of 59 publications, only 17 been identified by the mills as customers (others evide buying from jobbers) while only six had expressed diss faction with the treatment of manufacturers. In an inter ing clash between counsel for the publishers and a pa maker's counsel, the former agreed to let the latter scan publishers' financial statement, but refused to have the fig made public as was the case with costs of newsprint mak The Controller said that Finance Minister, Sir Thomas Wh was very reluctant to interfere with the law of supply and mand. There was strong pressure to have the publish business probed, it being claimed, that they were making h profits. There was severe criticism of the apparent un ground communication of information to the newspaper p lishers instead of through argument in public. There was an astonishing statement that the newspapers had been pr ised the privilege of going direct to the government. It stated that a newsprint price of 3 cents had been set in United States. Mr. Pringle finally recommended an inte price of $57 per ton for 3 months from February 1. worked out to be an average of only $52.10 from July 1, 1 to May 1, 1918. Then a strange event occurred. The order was to have become effective on February 1, but on day the publishers were heard by a subcommittee of Cabinet and the Controller's order was not confirmed. weeks later, however, the government approved the C troller's interim price of $57 a ton but ruled that the dif tial of $7.00 be held in a trust fund until the end of the int period. It is important to note that the paper control recommendation was not reviewed by a judicial but a poli body.

An awful tangle resulted from an Order-in-Council for distribution of the differential received by newsprint mills

Eastern Canada Power & Paper Co. mill at Clermont, Que. This eventually became property of Donohue Bros. Ltd.

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Heppenstall

CHIPPER KNIVES

durable blades for industry

Many leading pulp mills make Heppenstall their standard specification for chipper knives. Heppenstall's record for durability provides such production advantages as:

- MORE CUTS BETWEEN GRINDS
- LESS OVERSIZE CHIPS
- LESS DOWN TIME
- LOWER OVERALL BLADE COST

The reasons may be found in Heppenstall's high standards for the development and manufacture of chipper knives. Made from high quality, electric induction steels, these long-lasting knives are famous throughout the pulp producing industry.

Make Heppenstall *your* standard specifications.

Heppenstall

The most dependable name in forgings

PITTSBURGH 1, PENNSYLVANIA

Sales offices in principal cities

paper sold at prices higher than the figure set by the controller, to manufacturers supplying more than their share to Canadian publishers at the official price.

Canadian paper merchants at Winnipeg on March 4, organized the Canadian Paper Dealers Association. Provisional officers elected were: chairman, John Martin; vice-chairman, C. J. Kay; secretary-treasurer, A. C. Hunt. At a general meeting in Toronto on April 3, John F. Ellis was elected president; John Martin, first vice-president; H. B. Donovan, second vice-president; E. A. Munroe, treasurer; the secretary to be a paid officer, appointed by the Executive Board.

The Canadian Pulp and Paper Association held its annual convention the last week of January. F. J. Campbell was elected president and J. A. Bothwell, vice-president for 1918. The Technical Section re-elected J. S. Bates as chairman and C. B. Thorne as vice-chairman.

Brompton Pulp & Paper Co. extended its interests by acquiring the Howland Paper Co., at Howland, Me. Mills at Claremont, N. H., and Bellows Falls, Vt., had been bought previously.

Paper and Freight Cars Scarce

A scarcity of paper developed during the Spring. Pulpwood supplies were short because of freight car shortage in some districts, unattractive prices for wood, wastage of paper, and discouragement of added production by the adverse and uncertain price situation. The interim price of $57 was extended another month, although a price of $60 had been in effect for months in the U.S.A. J. L. McNichol was appointed pulp and paper expert to assist Auditor Clarkson in the further investigation of the books and records of paper mills. Meanwhile demands of labor for wage increases could not be met and the situation was causing concern. In the U.S.A. an agreement was reached between companies and employees to extend current rates until the final price of newsprint was set by the Federal Trade Commission, but not later than July 1. Canadian companies were included in the agreement.

After months of investigation, during which a temporary 3¢ price ruled in the United States, the Federal Trade Commission fixed the price for standard newsprint at 3.10¢ per lb. On this basis, F. J. Campbell, president of the Canadian Pulp & Paper Association, declared that this would mean a loss to Canadian manufacturers of $10,600,000 a year, being that much short of the value of 4¢ a lb. claimed as fair by the manufacturers. United States manufacturers said they would appeal the decision by the F.T.C.

War Labor Board Sets Wages

Following a series of hearings with representatives of employers and employees, the U. S. War Labor Board (W. H. Taft and F. P. Walsh, joint chairmen) issued an order which was accepted by both Canadian and American newsprint mills. Indoor workers to be paid on the basis of an 8-hr. day and outside workers on 9 hr. Basis for tour workers was 41¢ per hr; inside day workers, 38¢; females doing same work as males to get same pay; mechanical repair men, minimum 50¢, helpers 39¢. Provision was made for adjustment semi-annually according to changes in the cost-of-living index.

Action by Canadian Paper Trade Association brought about acceptance of a standard substance system for bond and writing papers, following the practice adopted in the United States.

Shortage of tin plate in England prompted a search for a suitable substitute for shipping jam. Experiments brought forth a cardboard container that proved satisfactory for 1, 2, and 5-lb. sizes and more than 3,000,000 containers were produced weekly.

At a joint meeting of three branches of the Society of Chemical Industry, Geo. Tomlinson described the manufacture of alcohol from sawdust and the editor spoke at banquet on chemistry in the pulp and paper industry.

Increasing interest in accident prevention was evident the activity of the Ontario Pulp and Paper Makers Sa Association and the articles by plant engineers appearin *Pulp and Paper Magazine.*

The Summer meeting of the Technical Section was he Toronto on June 6 and 7. Education—both technical an accident prevention—was the theme of the meeting a visit was made to the Toronto Technical School. Visitors also welcomed by Dominion Envelope & Carton Co. Hinde & Dauch Paper Co. of Canada. Following the con tion, the editor, accompanied by his wife, toured the mil Western Ontario and British Columbia.

The Honor Roll, as of June, 1918, showed: total er ments, 2537; killed, 118; wounded, 153; died, 7; missin prisoners, 13; decorated—M.M. 2; M.C. 7; D.C.M D.S.O. 1.

The Pulp and Paper Section of the U. S. War Indus Board made a ruling, effective August 20 that most grad paper, other than newsprint were to conform to stan weights. This meant fewer basis weights and lower maxi weights.

The Canadian Pulp and Paper Association had an inte ing exhibit at the Toronto National Exhibition. A spec prepared booklet describing Canada's pulp and paper indu was distributed, and several paper houses in Toronto supp well-informed attendants to answer the questions of the n visitors. Interlake Tissue Mills exhibited sterile creped p bandages and cellulose wadding.

Women were working in increasing numbers in the mil the war wore on. Women chemists and finishing room had already become established. Other jobs taken by fe labor involved heavier manual labor. Patriotic women much to relieve a growing shortage of men. The lack of w labor was even more serious than in the mills.

An important milestone was reached in the advan technical education when representatives of the Tech Section, Canadian Pulp and Paper Association, and T. met in Buffalo on September 16. A joint committee posed of George Carruthers, George Williamson, C. P. W low, R. S. Kellogg, and T. L. Crossley was formed. The p ration of a textbook suitable for correspondence as we classroom instruction was decided upon and J. N. Stephe editor of *Pulp and Paper Magazine of Canada* was appoi editor.

Temporary Newsprint Prices

With United States price of newsprint fixed (appare at $62, the Taft-Walsh Commission arranged with empl and employees for a new wage scale. Some provisions not entirely satisfactory because local conditions could no effectively covered in a general agreement.

Relief for newsprint manufacturers was seen in Contr Pringle's ruling fixing the price at $69 from July 1 to Dec ber 1. The *Montreal Gazette* agreed editorially that the p was reasonable, in view of evidence given. Others, howe immediately predicted an appeal. The United States p was soon raised to $70, and later in the year to $75.05.

The Woodlands Section, CPPA held a Fall meeting Montreal on September 20. Among the items discussed the matter of improving the forest, better logging meth Summer camp for discussion of operations.

C. F. Eckart in Hawaii discovered the principle of mulch sugar cane plantings with a tarred felt paper that smoth the weeds.

The outbreak of "flu" (Spanish influenza) made serious roads on the personnel of the paper industry. At Win Mills, for example, 500 cases were reported and a tempo hospital was set up. The mill was closed down. Many r reported much lost time and many deaths occurred.

from pulp to paper

ENGINEERING ASSISTANCE AT EVERY POINT

You can get sound engineering assistance at every point in your papermaking operation from Black-Clawson. From stock preparation on through the conversion of paper and board into finished products—the largest staff of specialized paper mill machinery engineers in the world is at your disposal.

Flexible and versatile, Black-Clawson engineering is based on years of actual mill experience on all papermaking processes, on all grades from condenser and tissue to the heaviest of boards. Call for Black-Clawson engineering assistance on your up-and-coming program, regardless of what it may be.

THE BLACK-CLAWSON COMPANY

HAMILTON, OHIO • MIDDLETOWN, OHIO • FULTON, N. Y.

"Writing Paper Costs More than Beefsteak" was the title of an article on the paper situation. A popular bond paper cost 38½¢ a lb. beef roast, 32¢, lamb 36¢, etc., all at wholesale.

When George Chahoon left Grand'Mere to take an important position with the United States Government (he never gave up his United States citizenship) the little station was crowded with those whose welfare he always had so much at heart. Laurentide was "big business," but The Boss made business a personal relationship that gave the community a unique character.

During 1918 the Industrial and Educational Press built the new plant at Ste. Anne de Bellevue that became widely known as Garden City Press, with its own post office—Gardenvale, Que.

The year 1918 closes with rejoicing that the war is ended and the realization of great problems in repatriation and absorption of men coming home, many in need of special rehabilitation.

1919

The year 1919 seemed to be marked, at least as far as the pulp and paper industry was concerned, with no excessive elation or enthusiasm over the end of the Great War, but was rather a time when everyone caught their breath and waited for someone else to make the first move. This attitude may have been a minor contributing factor to the harder times in the early 'twenties, in contrast to the steady increase in business activity which we have had after the recently ended conflict—an increase which many are beginning to realize cannot go on indefinitely.

There were a number of interesting articles in the 1918 numbers of this publication. One series in particular whose author was almost "ahead of his time" (a phrase loosely applied in wonderment to anyone who happened to have thought of something which we consider "modern" today), was that by R. B. Wolf, manager of the Spanish River mills, entitled, "Making Men Like Their Jobs." Mr. Wolf had evidently come up through the mill, but, on reaching a position of some eminence, had not forgotten the human factor in industry. Looking backwards, we can see this change in the attitude of management towards the employee. The term "hands" gradually disappeared, and there was more of a tendency to stress the human factor in an accident or fire than to mention any fatalities as merely being incidental to the property damage. Other noteworthy articles were by John Stadler on the application of power in the newsprint industry. Bjarne Johnsen and R. W. Hovey of the Forest Products Laboratory on the utilization of waste sulphite liquor, and Prof. C. D. Howe of the University of Toronto on "Patronage and the National Forest Menace." Mr. Stadler's rise to prominence was marked by the fact that his name was finally spelled correctly as a general rule, instead of being confused with that of a prominent hotel man. It must have also been a source of considerable satisfaction to George Chahoon, Jr., when his name began to appear in its correct form more often tha
Another noteworthy contribution made in the year 191
one which was of lasting value, was the institution of th
paign to raise $30,000 to prepare the manuscripts of th
and paper textbooks, under the guidance of J. Newell Ste
son.

As might have been expected, the fixing of the new
price at $69 pleased no one—the mills said it was too lo
the newspapers, in a better position to voice their objec
lost no time in squawking about the exorbitant figure the
to pay. Before the end of the year Mr. Pringle, the cont
admitted that he thought a $75 price would be about rig
view of changing conditions and increasing costs. Two
with a modern flavor were the sending of an exploration
into the Ungava district and the recognition of the spruc
worm as a menace.

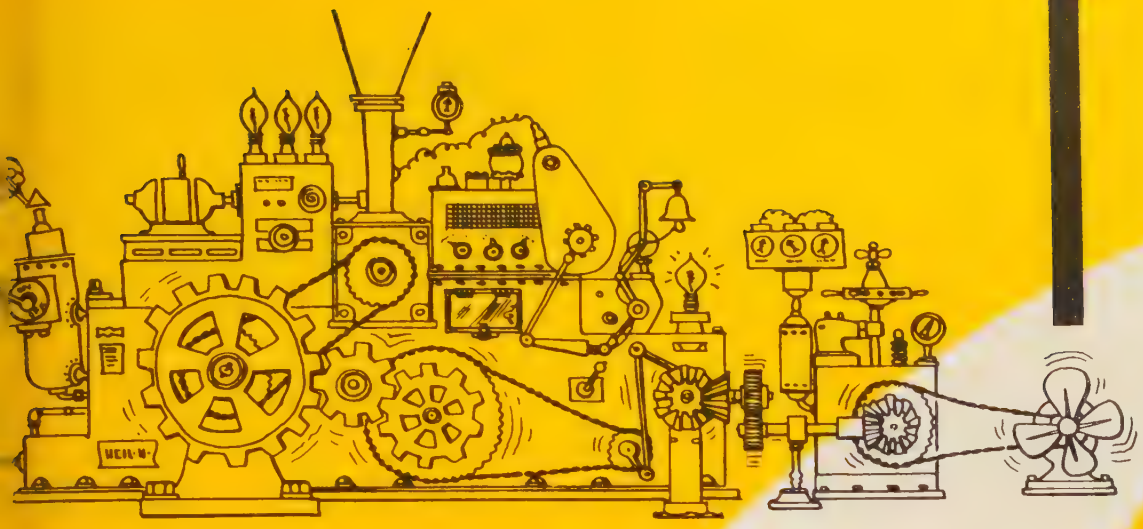
F. J. Campbell, retiring president of the CPPA, state
the year 1919 had been "one of the most important
history of the Association." John Stadler became cha
of the Technical Section. Billy Whyte left Iroquois F
become associated with Canadian Fairbanks Morse Co.
Whitehead was elected president of the Wayagamack P
Paper Co. H. R. MacMillan, who had been with th
perial Munitions Board during the war, became a repre
tive for a British lumber publication.

The Specialty Paper Mills Co. was organized to tak
the former Houpt mills at Camden East, Ont., from Ba
Lumber Co. Ltd. It was planned to convert them t
manufacture of newsprint. Howard Smith bought th
ronto Paper Manufacturing Co. mill at Cornwall and H
Smith Paper Mills Ltd. was organized. New paper ma
were installed at the Beauharnois mill of Howard Smit
at the Spanish River mills at Espanola, Ont., and the K
Pulp Co., a Riordon subsidiary, shipped its first pulp
Temiskaming. Price Brothers began on their Riverbe
velopment, planning to name the town "Saguenay."
Great Lakes Paper Co. Ltd. planned to erect a large n
Port Arthur, Ont. The Wayagamack Co. bought the Bi
limits, consisting of about 450 sq. miles, adjacent to the
River in Gaspé. The Belgo mill had a $100,000 fire, a
Trois Pistoles, Que., Brown Corp. lost a sawmill, 2,000,0
of lumber, and 3000 cords of pulpwood, due to some ch
playing with matches next door. Total loss was in the
borhood of $1,000,000. Average daily production of
print was 2775 tons in 1919.

1920

The price of newsprint continued to be a bone of conte
for all concerned—which in reality involved most of the
and paper industry and all of the publishers. The
started at $92, fixed by the Board of Commerce, a goverr
empowered body which took over the unwelcome task
the resignation of Mr. Pringle as paper controller. The
jumped to $100 before the end of the year, with export
fetching $110. These figures covered publishers buying

Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont.



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print on a contract basis in some quantity—spot purchasers, such as the smaller publications, had to pay up to twice these rates. The Board of Commerce tried to compel Price Brothers to furnish newsprint to the *Montreal Star* and others at the fixed price, but Price Brothers refused, fought the case through several courts, and emerged victorious. The Ontario-Minnesota Paper Co. became involved in a similar situation, and the decision in the Price Brothers case helped to strengthen its position. Mr. Pringel's resignation was generally believed to have been due to government interference with his branch, which resulted in a shortage of paper in the Winnipeg area and eventually in newspaper shutdowns there. Paper seemed to have been scarce all year, forcing the *Saturday Evening Post*, for example, to discontinue sending the magazine to Canadian subscribers after May 1, and sending up none for sale on the newsstands. Most mills seemed to have been working at near full capacity, but the demand was greater than the ability of the industry to produce.

New Mills Projected

There seemed to be a feeling of optimism in the air as far as business was concerned, as evidenced by many more transfers, mill improvement programs, and openings of new plants than in the years immediately preceding—years which were, of course, hampered by the Great War. New mills included Clark Brothers on the Bear River just above Digby, N. S., with A. G. McIntyre, formerly editor of the Canadian magazine, in charge. Plans were drawn up for a large mill at Kapuskasing, Ont., backed by American interests. The Beaver Board Co. or the Beaver Wood Fibre Co., as it was known in Canada, moved its Ottawa mill to Thorold to centralize its activities. This company later closed down, supposedly on a temporary basis in order to force wage reductions. It also absorbed the Foley-Rieger Paper Co. at Thorold during the year. Western Canada Pulp & Paper Co. succeeded the Rainy River Pulp & Paper Co. in British Columbia, with head offices in Toronto. The Wolf River Pulp & Paper Co. bought out the Riviere du Loup Pulp Co. at Fraserville, Que. The *New York World* bought the St. George Pulp & Paper Co. in New Brunswick, having already purchased the parent mill in Norwalk, Conn., in an effort to relieve its newsprint supply problem. The Hammermill Paper Co., with head offices in Erie, Pa., bought the Matane Lumber & Development Railway on Quebec's South Shore, together with 133,000 acres of timberland, and the Brompton Co. acquired 634 square miles in the Lake St. John area, more than doubling its holdings. Reorganization, largely to do with recapitalizations, were effected by the Laurentide Co., Abitibi, Howard Smith Paper Mills, Riordon (to consolidate the Kipawa mill with its other interests), and Price Brothers. J. Ford & Co. began construction work on no. 2 mill. In the affiliated field Waterous absorbed J. M. Voith Co. (Canada), and further developments of the new magazine grinders were promised. Harland drives also began to be recognized as being suitable for certain types of paper machines.

The *Pulp and Paper Magazine* continued to stress safety, and A. P. Costigane, secretary-manager, of the Ontario Paper Makers' Safety Association, was accorded space in almost every issue. One bad accident occurred during the year—a sluice gate carried away at Iroquois Falls, drowning four men. The use of cobwebs and kerosene or turpentine on open wounds was frowned upon. The employee continued to receive more consideration as time went on, with technical classes on papermaking being instituted at Iroquois Falls, and free life insurance being offered at the Belgo mill—up to $3000 for those who had been employed continuously for more than 10 years. The Spanish River Co. followed a similar procedure.

Fires Damage Paper Mills

A fire destroyed the old mill of Bennett Ltd. at Chambly Canton, Que., causing damage of about $200,000. An fire, caused by a severe electrical storm, damaged the G City Paper Mill at St. Catharines, Ont., and a boom bu Murray, C. B., N. S., belonging to the Cape Breton P Paper Co., allowing a large mass of pulpwood to be swe to sea. George Chahoon, Jr. was elected president of CP but the batting average on the spelling of his name cont poor, being wrong in one place and right on the facing It was, however, spelled correctly in the notice of his ele McGraw-Hill Co. of New York became the publishers pulp and paper textbooks. John R. Booth celebrated his birthday, and Col. W. J. Ray of Price Brothers was ten a dinner on the fiftieth anniversary of his employment the company. United States funds commanded a 19% mium.

1921

The slump which began to be noticeable in the last months of 1920 really made itself felt in the succeeding when there was a rapid swing-over from a demand whic ceeded production capacities to an oversupply of paper pulp, particularly the latter. Mills were forced to reduce prices drastically—in many cases below cost, as raw mat and supplies had been purchased when prices were at a level and the mills had no opportunity of cashing in befor recession was on. Newsprint, for example, was quote $130 at the beginning of the year and scaled down from $100, $88, to the $70 quoted by International Paper Co 1922 orders. Wage reductions became the order of the ranging up to 30%. The first ones, at Beaver Wood Co. in Thorold, Ont., and Minnesota at Fort Frances, Bathurst in New Brunswick, were met with walkouts. the seriousness of the situation became evident, however employees realized that half a loaf was better than no b and took whatever work was available. Many mills down completely and others ran on a part-time basis, bu fore the end of the year most of them had resumed no operations. The one big trouble spot was Riordon—w ran into financial difficulties just as the new Kipawa mi Temiskaming, Que., opened to produce bleached sulp pulp. After considerable jockeying the creditors agree give the company one year, to November, 1922, to me debts, the idea being to allow it to convert the wood in block pile into salable merchandise. One reason given fo trouble was the fact that the Kipawa mill was built wi much larger production in mind, so that water power other facilities were developed far in excess of immed needs. Provincial Paper Mills Ltd. was formed with the Provincial mills as a base, plus St. Lawrence Pulp & P Co. and Port Arthur Pulp & Paper Co. Canadian Ex Paper Co., under the presidency of H. Biermans, handled marketing and shipping of paper and pulp from the Lau tide, Belgo, Brompton, St. Maurice, Price Brothers, Hov Smith, Provincial and Interlake mills. Guy Tombs, man of the traffic department, later split off, with the blessin the company, and handled the actual shipping probl leaving the sales to the parent organization. Mills began erations at Nipigon, Ont., and Bear River, N. S.

On the woodlands end, Donnacona acquired the Jac Cartier limits from the provincial government for $700 a mile plus stumpage fees. The wooded limits on the M couagan and the power possibilities on the Outardes, bot Quebec's north shore, were offered with no takers. Fran D. Barnjum, of Annapolis Royal, wrote about the spruce worm menace. Tractors were used successfully in the w by St. Maurice Paper Co. of Cap de la Madeleine, Que.

Personalities involved in 1921 happenings included P B. Wilson, vice-president of Spanish River, who was ele president of the CPPA. Sir William Price endowing a ch istry course at Laval University, and Billy Whyte going his own" representing Ayers Felts and Niagara and Lin

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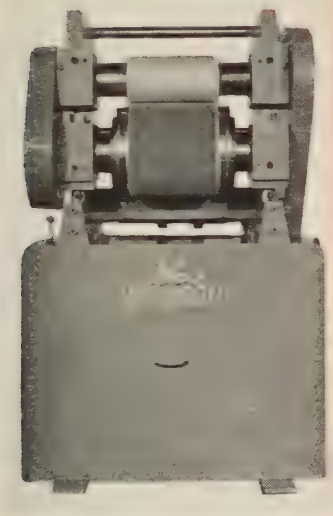
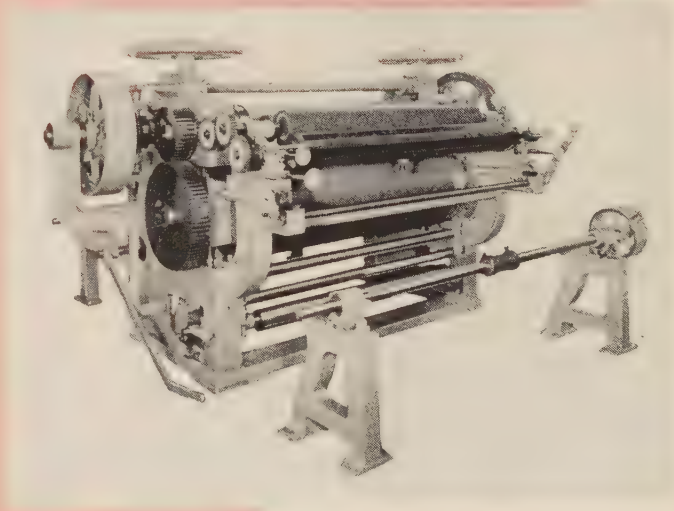


Waldron pneumatic laboratory scale embosser. This unit is capable of pressures to 5 tons on a 14" face.



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Wires. Sir William Gage, president of Kinleith mills, died, as did E. B. Biggar, first publisher of *Pulp and Paper Magazine of Canada*, and William Clarke, founder of Clarke City. A Technical Section student essay contest, was won by A. C. Copping, with entries also submitted by J. O'Halloran and E. D. Hyndman.

The Thorne barker and Nash pumps received mention in 1921 for the innovations they incorporated in their designs, and there was considerable space devoted to the protection of block piles by the use of water forced through spray nozzles. Preparation of the pulp and paper textbooks proceeded, and the appearance of the first book, on the science and mathematics as applied to the manufacture of pulp and paper was well received.

1922

Considerable interest was aroused by the announcement that Howard Smith Paper Mills, after considerable research, had begun production of blotting paper. This was the beginning of the manufacture of this grade in Canada.

A strike was called at the Garden City Press by the Montreal Typographical Union. This interfered with the production of *Pulp and Paper Magazine* to some extent, but all issues came out, though with occasional delay.

Correspondence Courses Established

On publication of the first two of the five volumes of the textbooks—"The Manufacture of Pulp and Paper"—classes were organized in several mill towns in Canada and the United States. At the suggestion of the Executive Board of the Canadian Pulp and Paper Association, the publishers of *Pulp and Paper Magazine,* organized the Institute of Industrial Arts to conduct correspondence courses in pulp and papermaking. These courses were continued until 1947 and some 1800 students enrolled from all over the world. This educational service is now conducted by the International Correspondence Schools.

Frank J. D. Barnjum launched his campaign for an embargo on the export of pulpwood from Canada.

Maurice Neilson's paper on the use of jack pine for newsprint marked the beginning of much research on this subject.

At the annual meeting of the Canadian Pulp & Paper Association, over which President P. B. Wilson presided, it was announced that Mr. Dawe had resigned as secretary and was succeeded by Edward Beck who had been manager of publicity for several years. George M. McKee, Donnacoma Paper Co., was elected president and H. F. E. Kent, Kinleith Paper Co., vice-president. A. E. Cadman was appointed assistant to the secretary. The Technical Section elected O. F. Bryant chairman and R. W. Hovey vice-c man.

An event of the year was the ceremony following the a luncheon by which George McKee was honored for memorating an old chief of the Mohawks. In a solemn r a party of Indians from Caughnawaga invested Mr. McK Chief Donnacona with the rights and prerogatives of his and clothed him in glory and garments befitting the occ And all the congregation shouted: "Hail Chief Donna Lord of Canada."

Paper Mills Seeks Australian Trade

A deputation from the Canadian Pulp and Paper Ass tion interviewed the government on the question of Austr and New Zealand tariffs on paper. The association ha ready suggested that a commission should be sent to Aus with power to negotiate an agreement.

A fire at Don Valley Paper Mills, damaged the preparation department and boiler house and machine Damage was estimated at $100,000.

Iroquois Falls was the mecca of the Technical Sectio their Summer meeting. The Abitibi folks were wonc hosts and the visitors found much to interest them in a conducted tour of the huge plant. The chronicler recall attack of nausea suffered by one of the guests because s body put cigarette ashes in his liquor—or so it was expla

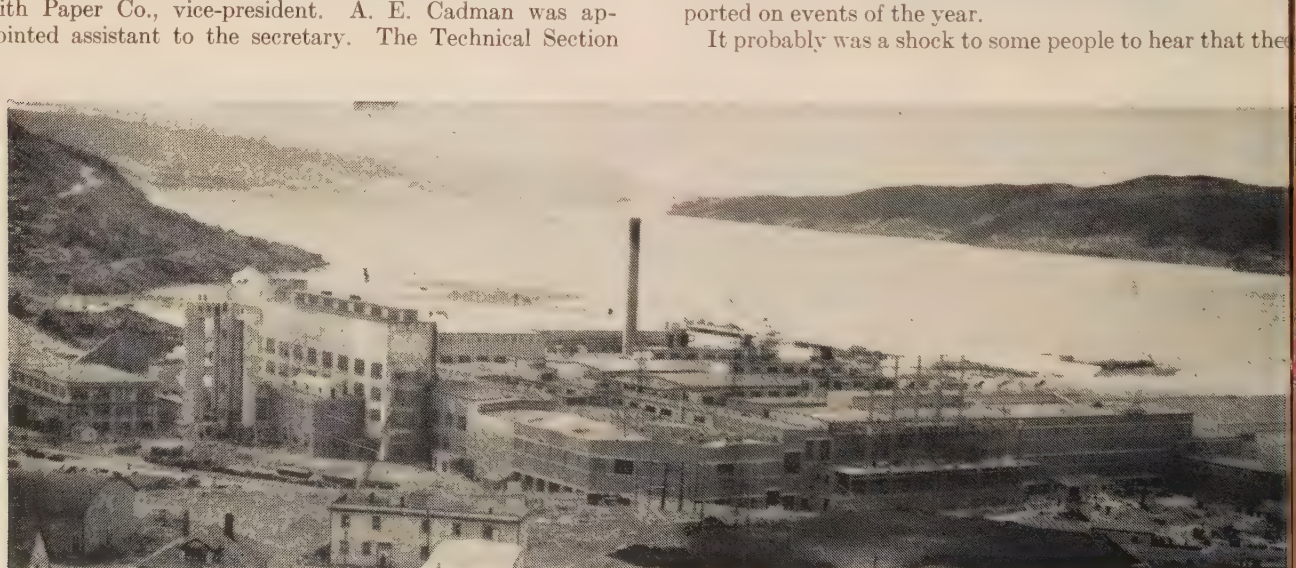
The seventh and largest annual meeting of the Can Paper Box Manufacturers' Association was held in Mon on June 26. A feeling of optimism pervaded the gath that the worst of the slump was over and that the sl "Business at a profit" might be prophetic.

In line with the above, announcement was made soon that a large producer of newsprint had raised its price $70 to $75 a ton. Apparently the tide had turned—or w the worm?

Volume 3 of "The Manufacture of Paper" was publ and was given very favorable reviews by prominent aut ties. O. F. Bryant concluded his comment with: "It i best book available on the manufacture of wood pulp." (30 years later, a fourth-rewritten edition of nearly twic size has been published.)

The fifth annual convention of the Canadian Paper T Association was held in Toronto on October 25 and 26. F. Ellis was elected honorary president, George Wilson ceeded C. J. Kay as president, J. B. Larkin, and P. I. Fir were elected first and second vice-presidents. Major ma of discussion were the report of the Mills Relations Comm and the new Goods Marking Act. Secretary N. L. Marti ported on events of the year.

It probably was a shock to some people to hear that the



Newfoundland Pulp & Paper Co. mill at Corner Brook

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IF YOU HAVE FOAM PROBLEMS AT ANY OF THESE 11 POINTS . . .

BEATER SWELLING
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FOAM AT THE SEAL BOX
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If you could see into your piping, as you can in the picture above, you might well discover the cause of many production troubles—*foam*. Sizes with a high foam index can create problems at many points in the papermaking process. Solution: simply switch *to Mersize*.

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Fort William Paper Co.

of a newsprint mill planned for Corner Brook, Nfld., was estimated to cost $18,000,000—probably the first undertaking with such an initial cost.

An extension at Belgo Mill, Shawinigan Falls, was built to house two 230-in. machines, one of which was being installed and the other was on order at the turn of the year.

1923

George M. McKee has this to say about the year 1922 and about the prospects for 1923 from the point of view of the pulp and paper industry, in an article appearing in the second issue of this magazine for 1923. "At the opening of the year 1922 the situation in the pulp and paper industry was not very cheerful, although there were several factors of encouragement and promise for the coming year. The industry, like most other industries, had been passing through the reaction from the industrial boom of 1919–20. The bottom of the depression had been reached and the reconstruction period was under way. The year 1922 closed with the pulp and paper industry well on the road to normal and 1923 can be faced with a well-founded optimism.

"Improvement has been shown in all lines of the pulp and paper industry in Canada during 1922. Production has been greater than in the previous year by from 10 to 30%, with the newsprint industry doing best. Present indications are that this state of affairs will continue for some time and the Canadian mills will be kept busy during 1923.

"During the year there have been various additions to existing plants and new plants put into operation. The early part of 1923 will see at least four new newsprint machines in operation with others to follow during the year which will increase the capacity of Canadian newsprint mills to over 4000 tons per day or about one and a quarter million tons a year, a big stride forward from 1913 when the total production for the year was 350,000 tons."

Mr. McKee resigned his position with the Donnacona Paper Co., and his CPPA presidency about 1 month before the expiration of his term of office, to accept a position in the United States. He later returned to Canada, and was instrumental in developing the news manufacturing end of the mill at Port Alfred, Que. He was succeeded as CPPA president by H. F. E. Kent, president and general manager of the Kinleith Paper Mills Ltd.

Other personalities mentioned in the accounts of the year 1922 included Sir William Price's presidency of Charles Walmsley & Co. Ltd. (Canada); the attainment of the age of 96 by Jo Booth; the opening of a New office by Guy Tombs; C. H Smith's presidency of the C.M.A. death of the Abitibi president Anson; Billy Whyte's directorsh Porritts & Spencer Ltd.; and the tion of Gifford Pinchot, a forest note, as Governor of Pennsylvania

Mills and Machines

The Backus-Brooks Co. at K Ont., ordered a 234-in. machine Dominion Engineering, to supple the pulp mill already in operation L. Warren purchased the Wolf Pulp & Paper Co. at Riviere du Que. The magazine contained a long write-up of t Maurice Lumber Co. mill at Three Rivers, Que., a subsi of the International Paper Co. This was described as the first all-electric mill and as using compressed air t the sheet through the machine. The furnish was 25% phite, 75% groundwood, and production was 300 tons on four 165-in. machines. Wood used was 60% spruc 40% balsam. J. Ford & Co. completed a new buildin installed a 120-in. cylinder machine, and Brompton Dominion Lime Co. to its holdings, which already inc two mills across the border.

On the other side of the picture we had the volu liquidation of the Specialty Paper Mills at Camden Ont., originally an enterprise of the Houck family of B N. Y. The Dryden Paper Co., a chemical pulp mill, ref the difficulties met with by many pulp manufacture going into receivership. Earlier in the year Sir Fre Becker reorganized the Ha! Ha! Bay Sulphite Co. at Alfred, Que., with R. O. Sweezey, then a member of vestment banking firm, as a director. He ran into t with his holdings, however, and his amalgamation was to disband. Mills involved were Sissiboo Paper & Powe Weymouth, N. S.; Clyde Pulp Co., Clyde River, N. S Lawrence Pulp & Lumber Co., Chandler, Que.; Chi Pulp Co., Chicoutimi, Que.; and the aforementioned P fred mill. The Japanese tidal wave, which caused su rific destitution on that island, also washed Canadian by eliminating a pulp market for the three mills of the W

Nashwaak Pulp & Paper Co. at St. John, N. B.

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reflects the experience and skills of its makers.

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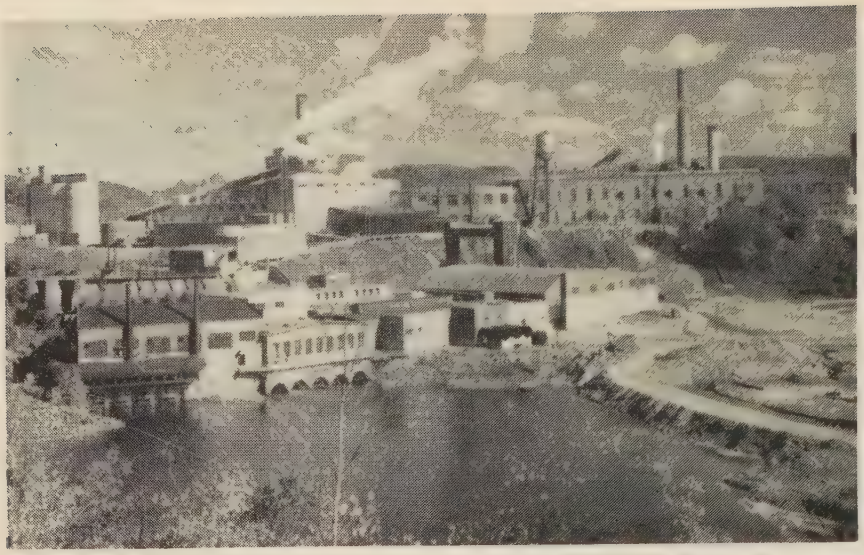


Spanish River Mill at Espanola, Ont.

Pulp & Paper mills in British Columbia, which was forced into receivership. The Riordon Co., also went through a reorganization.

On the woodlands end, a woodlands section of the magazine made its first appearance. The editor blasted the projected moving of the Pulp and Paper Division of the Forest Products Laboratories to Ottawa, apparently with some effect, as they remained in Montreal. The Hammermill Co., manufacturers of fine papers from sulphite pulp, were logging in the Port Arthur district. Another American company developing Canadian woodlands operations was the St. Regis concern, which opened up a slashing and barking plant of 40,000 to 50,000 cords capacity, with a long flume and dock for loading the pulpwood into boats, in the then wilderness of Quebec's North Shore at Godbout.

Other changes noted by the magazine were the holding of the Summer Technical Section meeting at the home office of this publication in Ste. Anne de Bellevue, Que., the opening of the Quebec Pulp and Paper School at Three Rivers, and the articles on Briner economizer hoods and Cottrell precipitators. Two fires of note occurred during the year—one destroyed the International Fibre Board Co. mill at Penetanguishene, Ont., and the other, in the chipbin of the Spruce Falls mill at Kapuskasing, Ont., resulted in the death of two employees.

1924

H. F. E. Kent, outgoing president of the CPPA, supplied a statement for the Montreal *Gazette*'s Commercial and Financial Review covering the year 1923. He noted that the year had been one "of considerable activity and expansion," especially in newsprint with total production for the year being around 1,276,000 tons. Five more news machines were expected to be put into operation early in 1924, adding 450 tons daily capacity. He looked for "a steady activity in most pulp and paper lines" for 1924. The new president of the CPPA was George Carruthers, president of Interlake Tissue Mills Ltd. who had been chairman of the Technical Section, and of the Joint Textbook Committee since its inception.

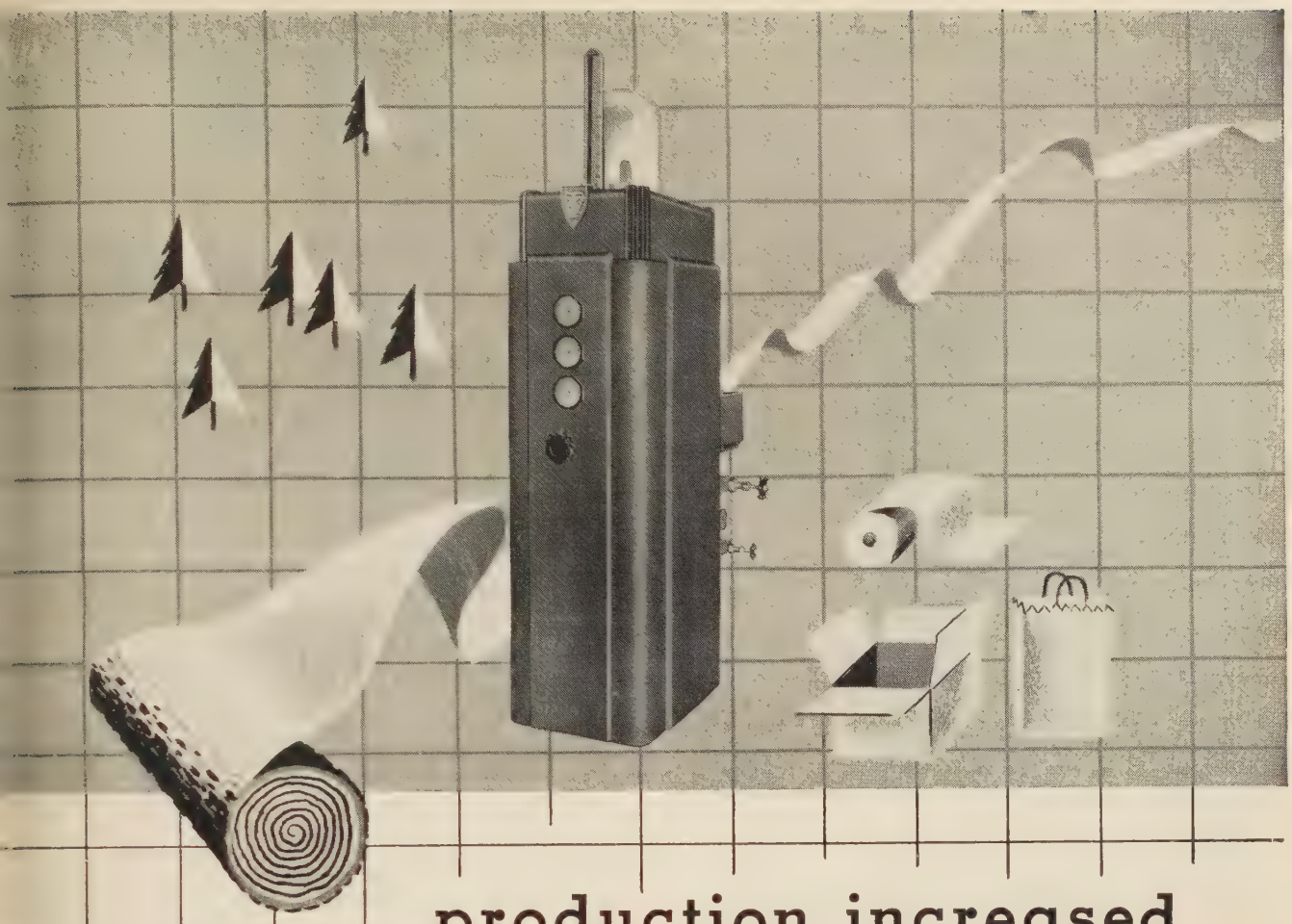
The Royal Commission on Pulpwood, after spending $70,000 investigating the advisability of placing an embargo on pulpwood being shipped out c country before being processed, ca with a double-talk report which the buck right back to the goverr Frank J. D. Barnjum, who hac writing and speaking for years c necessity of such a move to pr Canada's forest resources, gave disgust and offered his Canadian ings for sale.

Floods caused two major los 1924—one resulting in consid damage to the Bird & Sons mill a Rouge, Que., and the other, at gami, causing the death of one industry's leaders, Sir William Pric the first case, employees had to w waist-deep water to board up th windows from outside to preven rampaging Jacques Cartier River smashing the paper machine wit wood carried in its swirling w The river rose 22 ft. in 24 hr. and c away most of the approaches to th as well as causing considerable damage to the interior. A nogami, flood conditions had caused heavy damage, a William Price and two engineers were standing on a bank above the river to assay the damage and to decide w or not to dynamite a dam to relieve the pressure. Sudd large wave swept down, undermining the bank on which were standing, and carrying Sir William with it. His was found several miles downstream, and he was buried point of land overlooking the river valley. The only disaster of note was an explosion of a low-pressure boiler Lincoln Paper Mills, Merritton, Ont., which did conside property damage but only one employee was slightly in when he was blown into a large vat.

In his last year Sir William Price, with Gerard Powe Norman Brown, was one of the organizers of the Q Forest Industries Association. He also teamed up with B. Duke, the southern tobacco magnate, to organize the Price Power Co. for the further development of water in the Lake St. John district. The Price Brothers mil Joseph d'Alma, Que., was started, which was to be kno the Riverbend Mill.

New paper machines were installed at Belgo, a 2 Dominion to run at 675 f.p.m. and at Donnacona. Brothers machines at Kenogami seemed to be having a

Mersey Paper Co. at Brooklyn, N. S.



production increased up to 15 tons per day...

. . . with W & T chlorination equipment

A Southern mill had been having trouble with paper breaks attributable to the presence of slime in their white water. Despite continued efforts to control them slime breaks were running 60 to 80 per week, resulting in a time loss of 10 to 14 hours per week, and an average production loss of 15 tons per day! It was then that the W&T man was called in. Where and how to apply the proper treatment was determined, the costly methods were discontinued, and W&T chlorination was installed.

During the first 3 days of chlorination the mill recorded only 1 slime break and 2 minutes of lost time.

During the next 3 days there were 4 breaks and 17 minutes of lost time.

During the next 25 days there were no breaks attributable to slime!

. . . Within a week there were no production losses caused by slime! Performance such as that is typical of what your W&T representative can do for you.

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and-neck race with the new ones at Kenora, with the final figures quoted a record for a 24-hr. period of 110.8 tons. The pulp market continued uncertain, with the resulting liquidation of the Glengarry Pulp & Paper Co. at Cornwall, Ont., formerly the Cornwall Pulp & Paper Corp. The Bathurst mill closed its pulp producing facilities temporarily. Clark Brothers at Annapolis Royal, N. S., sold their assets to the Bear River Pulp Co. Ltd. which, backed by American interests, intended to put the mills into operation. The Riordon assets were parceled and offered for sale, and Daverin Paper Mills Ltd. took over the Lennox Paper Co. at Camden East, Ont., the former Houck interests. Bay Sulphite Co., one of the former Becker units, was taken over by Port Alfred Pulp & Paper Corp. with plans to install two paper machines, and the Port Alice, B. C., mills reopened.

Other miscellaneous notes on pulp and paper activities included the attainment of the age of 97 by John R. Booth, the use of aeroplanes in a survey of the power possibilities of the Outardes River on Quebec's North Shore, and the accumulation by the Laurentide Co. of a record-breaking block pile of 130,000 cords.

British Empire Exhibition

The Exhibition at Wembley provided a unique opportunity for the *Pulp and Paper Magazine* to be of service to the Canadian pulp and paper industry. When the Canadian Pulp and Paper Association decided to participate in the British Empire Exhibition, the publishers of this magazine offered the services of the editor and arranged for T. L. Crossley to carry on in his place from the end of March to the middle of October. We were allotted a solid section comprising ten show windows in pairs with a cupboard in the middle of each pair. Each window was about 6 by 4 ft. and 3 ft. deep. A platform about 4 ft. wide ran the full length, which was used for sticks of pulpwood, a roll of newsprint, etc. This was one of the largest industrial exhibits in the Canadian Building. Each show space was occupied by a firm or group of associates who supplied material for their displays. Thirty-four companies participated.

By dint of hard work, with advice and assistance from London representatives of Canadian firms and the government, the displays were all in place when the exhibition opened on April 23. In attendance besides the writer were Tom Nesbit of Price Brothers & Co. and Miss Archer from Garden City Press (now on the staff of the Woodlands Section). Visitors from Canada included Edward Beck, secretary of Canadian Pulp and Paper Association, Dave Crabtree, and Coosie Price. Many Britishers, connected with chandising or converting firms, were interested caller wanted first-hand information on the Canadian industr products.

Highest day's attendance at the Exhibition was 321,C Whit Monday. The crowning event of our stay in Londo the visit of Queen Mary and several other members Royal Family. Her Majesty showed particular interest display of rayon silks, brocade, etc. and the pulp used to it, and examined the hosiery. The late King George V absorbed in the window where moving sleighs, trucks, and ship represented the course of operations from the to the wide world of paper consumers. The low spot Exhibition was the day a tremendous downpour overf the roof drains and streamed over the Interlake displ thirty-seven colors and flowed down the aisle like a ri blood. Fortunately, the company had sent a generous s of material and the exhibit was soon done over. Perha should also relate how we invited Dave Crabtree over t West Indies pavilion for a "swizzle," only to find af half-mile hike on a very hot afternoon that the bar was from 3 to 6! The writer was even more embarrassed th John Wolstenholme of Chas. Walmsley's came with hi for lunch, which cost more than our funds and we had t row a pound from our guest!

Anyway, the whole affair was a fine show and was aw a certificate of excellence.

1925

In his report covering the year 1924, George Carru president of the CPPA noted that newsprint again led i gains made by the pulp and paper industry, with seven nev chines being installed, bringing the total capacity to just 5000 tons per day. Another 550-ton increase was anticip in 1925. He noted with some concern the fast-dwin wood supply, and suggested that the association devote of its efforts to "preserve and perpetuate the supply of upon which our industry exists." Other speakers a annual CPPA meeting were Sir John Willison, British licist, and Edward W. Beatty, president of the CPR. W. Clarke of the Gulf Pulp & Paper Co. was elected as t president.

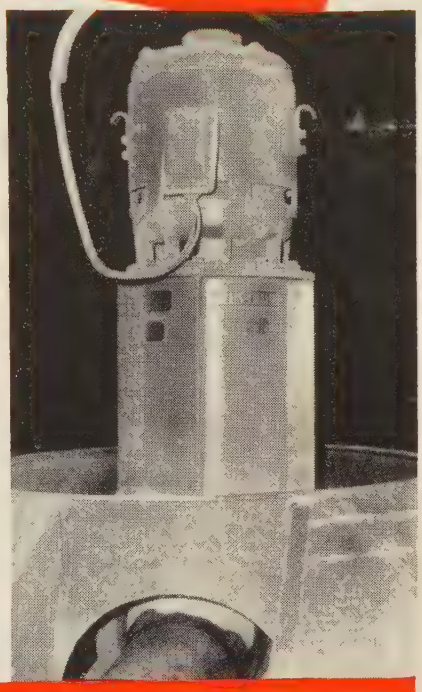
As it turned out, there were 11 new machines which into production in 1925, with those in Newfoundland le the way, and production increased 890 tons daily inste the estimated 550. Total production for the year was 141,

Anglo-Canadian Pulp & Paper Mills Ltd. at Quebec

NEW Side-Flo UNIT

Uniform Stock Flow Throughout Chest

- Prevents Piling Up on Edges
- Stops Lumping, Drying Out
- Cuts Stock Contamination
- Eliminates Plugging of Pump and Pipe



THE *Side-Flo* unit, made by Allis-Chalmers, greatly improves the distribution of stock entering the chest, prevents the accumulation of dried out stock in pockets and allows the stock to flow out of the chest evenly. The result is higher quality product and less downtime for clearing stoppages or cleaning old stock from the chest.

The *Side-Flo* unit is adaptable to practically any size and shape of chest. It can be installed on old or new chests without major alterations. For information, call your nearby Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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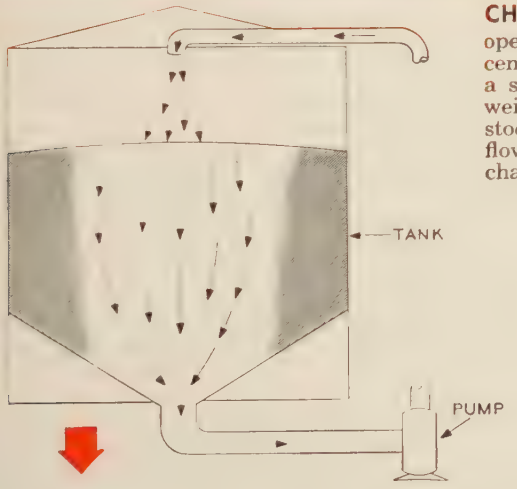
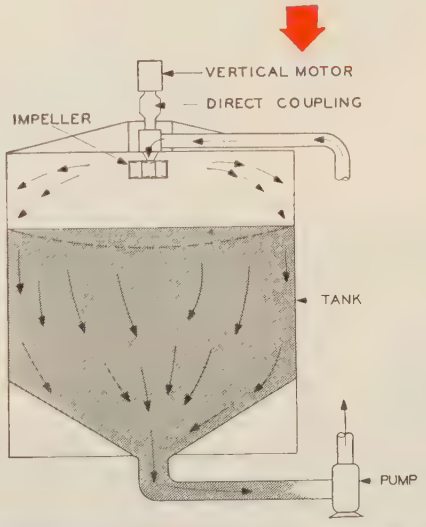


CHEST WITHOUT A *SIDE-FLO* UNIT — Where flow is into the center of the stock chest, the stock has a tendency to pile up and add weight to the center. This slight weight increase at the center, coupled with the intake directly below, causes a channeling effect of the stock through the center of the feed chest. Stock at the sides has a tendency to thicken and dry out. When this stock does break loose from the sides, it has reached the stage where it contaminates the final product, and since it breaks off in large lumps, it may clog the pump or pipe.

CHEST WITH *SIDE-FLO* UNIT — With a *Side-Flo* unit in operation, stock enters the chest through the impeller in the center and is thrown to the outer walls of the chest. This causes a slight buildup around the outer edge of the chest. Added weight causes edge flow to take place, while at the same time, stock in the center of the chest will flow due to the periphery flow and location of the discharge. The overall effect is a discharge from the entire chest cross-section area.



Side-Flo is an Allis-Chalmers trademark.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

000 tons of newsprint and 100,000,000 tons of various grades of pulp. Among the paper machines completed during the year was the first installed by Charles Walmsley (Canada) Ltd., a 234-in. one for The E. B. Eddy Co. This company also received an order for a 232-in. machine for Powell River in British Columbia. Others put into production included those at the Newfoundland Pulp & Paper Co. at Corner Brook, the Fort William Paper Co., Beaver Wood Fibre Co. at Thorold (a 166-in. Pusey & Jones news machine running at 750 f.p.m.), and two 164-in. machines at Wayagamack, designed to produce over 200 tons daily.

The grim reaper finally called a number of prominent men in the pulp and paper industry, foremost of whom was John R. Booth, who died on December 8 in his 99th year. Joseph Kilgour, president of Canada Paper Co. and R. H. Campbell, director of forestry for the federal government, also passed away, the latter as the result of being thrown from a handcar on a northern Ontario railroad line. James B. Duke, the American tobacco king who was interested in the development of waterpower in the Saguenay district, died on the anniversary of the death of his former partner in this enterprise, Sir William Price.

Anglo, Gatineau Mills Planned

Definite plans were formulated for the erection of a number of large mills, among which were the Anglo-Canadian mills in Limoilou, just across the St. Charles River from Quebec City. This was done partly to fulfill the provincial government's requirement that a mill be erected within 8 miles of one of the cities of the province within 18 months after being granted the limits. The Canadian International Paper Co. planned to erect a large new mill on the Quebec side of the Ottawa River slightly downstream from the capital, and the Three Rivers mill was to be enlarged with the installation of new machines, bringing the number of machines up to eight and daily production to 700 tons. James Murray, formerly manager at the Three Rivers mill, moved to Ottawa to take over the new plant. Final plans for the absorption by this company of the Riordon interests were completed.

On the other side of the picture there was the failure of the Bear River Pulp & Paper Co. in Nova Scotia, and the offer of the Whalen assets for sale on the west coast. The Mattagami Pulp & Paper Co. in Ontario went into receivership. Lincoln Pulp & Paper Ltd. was formed to take over the business from Lincoln Mills Ltd., and the possibility of an Abitibi-Spanish River merger was mooted.

Advertisements in 1925 offered the Van de Carr slice, the Voith high-pressure inlet, and Norton artificial pulpstones. G. L. M. Hellstrom opened a Montreal office for the sale of paper mill machinery and equipment. The St. Lawrence Seaway plan was discussed.

L. R. Wilson, vice-president and general manager of [illegible] Power & Paper Co. Ltd., was elected as the new presi[illegible] CPPA, to succeed Frank Clarke. The year 1925 saw C[illegible] only a bit behind the United States as a producer of new[illegible] —1,522,000 tons to 1,530,000 tons, respectively. Exp[illegible] of Canadian newsprint production continued, howeve[illegible] 18 new paper machines projected for 1926 with a tota[illegible] Canadian production of 1715 tons.

1926 seemed to be a more or less normal year, with l[illegible] real import taking place. There were a number of per[illegible] changes, with people well known in the industry today r[illegible] into new positions. R. A. McInnis resigned from h[illegible] managership at Iroquois Falls to take over as manager [illegible] new Anglo-Canadian Pulp & Paper Mills Ltd. plant [illegible] constructed in Quebec. John Stadler left Corner [illegible] Nfld., and set up an office in Montreal, in connection w[illegible] Newfoundland Pulp & Paper Co. E. A. Wallberg from T[illegible] became interested in developing a new industrial site [illegible] Lake St. John area, and formed the Wallberg Pape[illegible] which eventually became the Lake St. John Power & [illegible] Co., located on the Mistassini River near the well-[illegible] Trappist monastry. The new town was named Dolbeau[illegible] the first monk to settle in the vicinity, and connecti[illegible] facilities were provided. Mr. Stadler designed the m[illegible] became its first manager. R. W. Hovey left the Abiti[illegible] to become manager of Nashwaak Pulp & Paper [illegible] Saint John, N. B. C. C. Irving became manager of the [illegible] toba Pulp & Paper Co., which went into production [illegible] the end of the year. C. R. Van de Carr severed his conn[illegible] with the Laurentide Co. to become the manager of th[illegible] Anne Paper Co. mill at Beaupré, P. Q. H. Bierma[illegible] Canada and the Belgo mill at Shawinigan Falls, Que., to[illegible] in Paris. Harold Hibbert was appointed Mrs. E. B. [illegible] Professor of Industrial Cellulose Chemistry at McGill.

Mergers and Mill Miscellany

Building Products Ltd., was formed by amalgamati[illegible] Bird & Sons interests with those of Ruberoid. The ne[illegible] pany began with mills in Quebec Province, at Pont I[illegible] Portneuf, and Montreal, plus the original Bird roofing p[illegible] Hamilton, Ont. Anticosti Corp. was jointly formed b[illegible] St. Maurice Valley Corp., Wayagamack Pulp & Paper[illegible] and Port Alfred Pulp & Paper Ltd. to purchase the isl[illegible] Anticosti from the Menier family. This island is 31 [illegible] miles in area, or one-and-one-half times the size of [illegible] Edward Island, and at the time of purchase was believ[illegible] have 15,000,000 cords of pulpwood on it. Plans were im[illegible] ately formulated for harvesting and shipping the wood [illegible] St. Maurice Valley Corp. also absorbed Canada Pape[illegible]

Thunder Bay Paper Co. Ltd. at Port Arthur

WAX PROTECTION that leads to PROFITS

NOPCO*

WAX SIZES

Although they have no problems of cost-cutting and selling, bees employ the best wax they can obtain to protect their product.

How much more important for you to do likewise, if you produce sized papers and boards that must meet competition and yet be produced economically enough to help you make a profit?

It's a situation that calls for your careful consideration of Nopco Wax Sizes—the sizes which have been expressly developed to meet the needs of the paper, paper board, and fiber board manufacturer. With Nopco Wax Sizes, you can give your products exactly the protective properties you seek to impart. In fact, you obtain just the results you desire—with gratifying *economy*.

And remember, Nopco distribution is nationwide, and our technical representatives—convinced that helping you sell *your* products is the surest way of selling *ours*—will gladly work closely with you . . . in your own mill, if you wish.

We particularly refer you to—

NOPCO'S NEW ACID-STABLE SIZE:

Nopco 2252-A—a widely-accepted surface and beater size which resists acid, alum, and alkali. Uniformity guarantees superb performance.

NOPCO'S ALUM-SENSITIVE SIZES:

Nopco 2252—the ready-to-use, liquid paraffin wax size (with particle size less than ½-micron) that is ideal for waterproofing insulating board, butchers' wrap, and other internally sized grades.

Nopco 2251-X—the anhydrous size that saves freight and is extremely easy to use. A perfectly balanced wax and emulsifier.

Nopco 2251 and Nopco 2251-B—anhydrous, freight-saving, wax emulsifiers that will carry the highest amount of paraffin wax consistent with good emulsion stability. Particle size less than ½-micron, and quick alum sensitivity assure complete retention by fiber.

LOOK TO NOPCO ALSO AS YOUR SOURCE OF SUPPLY FOR:

Foam Killers • Sulfated Oils • Emulsified Resins • Coating Compounds • Wax Emulsions and Emulsifiers • Rewetting Agents • Insoluble Metallic Soap Dispersions • Sheet Formation Aids • Plasticizers • High Free Rosin Sizes Pitch Dispersants.

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*Reg. U. S. Pat. Off.

Abitibi mills, Beaupré, Ont.

adding it to its holdings in Cap de la Madeleine and Shawinigan Falls. The assets of the Mattagami Pulp & Paper Co. were sold at auction, and the Caledonia Pulp Mills in Nova Scotia were destroyed in a $100,000 fire. At the Canadian International Paper Co. mill in Three Rivers the first of four new machines was started up, which eventually were to increase the mill's production to 700 tons daily. The new machine was started up at 800 f.p.m. and ran off its first 10 tons without a break. The driers were driven by a new arrangement for paper machines—with worm gears.

The Canadian began its "Safest Mill in Canada" contest, offering two shields for annual competition in the interest of accident prevention. Other editorial high lights were a two-page poem by T. Lindsey Crossley entitled "My Paper," in which each part of the mill was poetically portrayed, and articles appeared on esparto pulp and deckle strap removal. Oil circuit breakers made their appearance in the advertisements.

The biggest news story, outside of the financial moves, was the explosion of a beater roll at Interlake Tissue Mills Ltd., Merritton, Ont., which occurred in a roll which had never been opened since it was purchased as second hand 6 years before. The explosion occurred as an employee was drilling out a jammed stud, and the blast killed two men, injured three more, and caused considerable property damage. Investigation revealed that the beater had been purchased from the munitions board, and that it had been used for beating a nitrocellulose solution. Some of this material had evidently seeped in around the beater bar filler strips before they had swelled sufficiently to fit tightly against the beater bars, and had dried out into a high explosive. After the explosion it was realized that there was another beater roll which had also not been opened since its purchase. A barrier of alum bags was built around it and C. Nelson Gain, the mill manager, rather than risk an employee's life for the job, took a long drill and bored through one of the filler strips, through which a solution was injected to neutralize the nitrocellulose.

1927

In his review of the activities in the pulp and paper industry for 1926, L. R. Wilson, president of the [illegible] remarked that "the industry [illegible] sents a capitalization of we[ll] half a billion dollars, and th[e] annual value of its products [is] proximately $250,000,000 a y[ear] which its contribution to the [export] trade of the Dominion amou[nted] $175,000,000, accounting for [one-fifth] Canada's exports." He sou[nded a] warning note on that fact th[at in] some branches, the expansion [of the] industry appears to have [gone] discretion, with a potential [output] of 2,000,000 tons of newsprint [annually] and still further production [coming] on the market." He decri[ed the] dependence of the Canadian pu[lp and] paper industry on the pro[duction] south of the border, and did n[ot feel] that a cut in newsprint prices [would] increase the demand, as the most important factor i[n con]trolling the size of any newspaper was the amount of [adver]tising linage it carried, not the price of the newsprint on [which] it was printed. He noted with satisfaction the atten[tion] stabilize the pulpwood supply, but stated that 20% [of the] pulpwood cut left Canada in an unprocessed condition.

Following the same line of thought, production figu[res] ward the end of the year revealed that Canadian mil[ls were] operating at 84.1% of capacity and United States m[ills] 80.1%. Other figures of interest were that newsprint w[as sell]ing at about $65 and wood was costing the mills about [$12] cord.

Prestidigitation

The year was characterized by a number of imp[ortant] mergers and other changes in financial setups, of whi[ch the] amalgamation of the Abitibi and Spanish River interes[ts was] the most important. By a common stock exchange [the] Abitibi obtained control of Spanish River, Fort William [Power] Co., Manitoba Paper Co. Ltd., Ste. Anne Paper Co. Lt[d.]

Head office of Abitibi Power & Paper Co. in Toronto

Finch, Pruyn and Company, Inc., Mill at Glens Falls, New York

Finch, Pruyn gets superior pulp for igh-grade printing and converting papers

with the

DU PONT PEROXIDE PROCESS FOR GROUNDWOOD BLEACHING

Lyman A. Beeman, president, says: *"Groundwood bleaching by the Du Pont Peroxide Process has moved groundwood papers into new fields of application. The greatly improved brightness and cleanliness of these new papers have made it possible for Finch, Pruyn and Company, Incorporated, to better serve the need of printers and converters for papers of high quality and low cost."*

Bright, clean groundwood pulp is essential for the igh-quality papers produced by Finch, Pruyn and ompany. They've been obtaining it efficiently and conomically since 1949 with their Du Pont Perox-de Bleaching Process. In fact, bleaching operations ave proved so successful that an additional Du Pont rocess is now being installed—boosting capacity om the present 120-130 tons to approximately 200 ns per day!

More and more mills are finding the Peroxide leaching Process ideal for producing papers with e proper brightness, strength, opacity and printing properties. And, like Finch, Pruyn, they all welcome the prompt attention that Du Pont's technical staff gives to problems of construction, installation, operation and constant improvement of the process. Be sure to find out how this modern bleaching process and Du Pont service can improve *your* product.

YOU CAN ALSO USE peroxide bleaching for soda, sulfite, semi-chemical and kraft pulps and for waste-paper recovery. We'll be glad to supply technical assistance for specific applications. Just send the coupon below to get more information about Du Pont peroxides and the Du Pont bleaching processes.

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FOR WOOD PULP BLEACHING

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☐ *Please send me literature checked below.*

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☐ Peroxide bleaching of sulfate pulps
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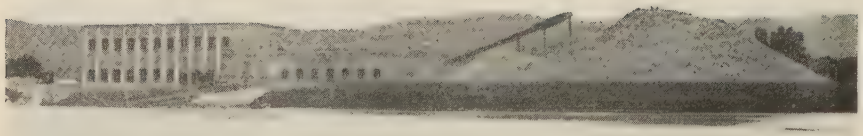

Lake Sulphite mill at Nipigon, Ont., now owned and operated by St. Lawrence Corp.

Murray Bay Paper Co. Ltd., thus forming a group with assets in excess of $178,000,000. The Abitibi Fibre Co. Ltd., was formed to take over the assets of the Mattagami Pulp & Paper Co. at Smooth Rock Falls, Ont., which were purchased at auction for $7,000,000. Scott Paper Co. purchased the Nova Scotia Wood Pulp & Paper Co. at Charleston. Western Canada Pulp & Paper Co. was formed, which took over the pulp mill at Port Mellon, B. C., which formed part of the assets of the defunct Home Bank of Canada. The Daverin Pulp & Lumber Co. at Camden East, Ont., fared no better with the mills there than had the Houck project and it, too, went bankrupt. The International Paper Co. took an option on the Corner Brook, Nfld., mills which were being operated at a loss by the Armstrong-Whitworth interests in England. These

eventually landed in the Bowater
of influence. Mills opening duri
year included the Gatineau mill of
dian International Paper Co. wi
largest news machines in the worl
in. wide, with a daily rated produc
600 tons. Other mills opening in
those of Ste. Anne Paper Co. at Be
Que., the Hinde & Dauch straw
plant at Trenton, Ont., and the C
Cellulose Co. soda pulp mill at Co
Ont. This company, a subsidia
Howard Smith Paper Mills Ltd
E. W. Tomlinson as mill manager.
projected included Spruce Falls Po
Paper Co. at Kapuskasing, Ont., a
New Brunswick International Pap
at Dalhousie, N. B. On the sales e
Canadian Newsprint Co. Ltd. was formed which too
the sales organizations known as the G. H. Mead C
Canadian Export Paper Co., and the St. Maurice Sal
Through the above and those other independent com
which came into the new group on its formation, a
proportion of Canadian newsprint production was
marketed by one concern. The cornerstone was laid
Pulp and Paper Research Institute of Canada in Mo
on the McGill campus.

A. M. Koroleff arrived on the scene to take up his du
logging engineer with the Woodlands Section of the
Regarding the mills, Minton driers and Thorne barker
written up and installations described.

Murray Bay Paper Co. Ltd.

Improve wet rub...

vax... brightness...

of starch-clay coatings with

RCI BECKAMINES

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And you'll also get this happy by-product — a brighter coating and a boost in Dennison wax of one whole number.

"Starch reactivity" is the reason RCI BECKAMINES produce these advantages. They form a water-resistant chemical union with all three types of starch customarily used in these coatings. Add them during the cook, at top heat as a chill-back, or to the cooled, finished adhesive. They blend perfectly with the starch at any stage.

If you make your coating with properly catalyzed BECKAMINE, notice how uniformly the brush or roller spreads it, even though your color has high apparent viscosity. That's because BECKAMINE actually decreases the viscosity of starch-clay coatings.

RCI makes two BECKAMINES . . . P-679-65 and P-685-50 . . . for starch-clay coatings. You'll find full data on both in Technical Bulletin P-1. Write for your copy today.

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PULP, PAPER, AND BOARD IN THE UNITED STAT

Review for 1953

W. LeROY NEUBRECH

TOTAL apparent consumption of paper and board in the United States in 1953 was approximately 31.4 million tons, exceeding any previous year by about 1.4 million tons. In 1951 and 1952 total annual consumption was approximately 30 million tons. This observation is based upon the relationship of United States paper and board consumption to the Federal Reserve Board index of industrial production, which rose to about 236 for the year 1953 (1935–39 = 100) compared with the index of 220 in 1951 and 219 in 1952.

It will be recalled that in 1951 there was a tremendous upward surge in domestic production of paper and paperboard to a total of 26 million tons. A part of this production, as well as a part of imports, was in excess of actual consumption needs and went into inventories. In 1952, production of 24.4 million tons was below consumption needs, and accumulated inventories in many grades were liquidated throughout the year to approximately normal relationships by December, 1952. A noteworthy exception was newsprint, largely imported, which built stocks an additional 94,000 tons in 1952.

Taking 1953 production of 26.6 million tons and adding imports of 5.2 million tons results in a new supply available for distribution of 31.8 million tons. Subtracting United States exports in 1953 of about 400,000 tons leaves a balance of 31.4 million tons, which apparently went into actual consumption during the year. Available data on inventories of paper and paperboard seem to indicate that for the year 1953, as a whole, there was little change from beginning to year-end inventory.

The year 1953 was marked by a continuation of the over-all capacity expansion of the industry encouraged by the Government's Tax Amortization Program. There still remain a few important expansion projects under construction that for the major part are expected to come into operation some time in 1954.

Capacity expansions have been accompanied by general streamlining of production facilities, from logging operations through the woodyard, in paper and board mills and in converting installations. New manufacturing techniques and processes have been introduced in many mills, resulting in greater operating efficiencies, improvements in properties and quality, and in increasing diversity of products.

This trend toward modernization was also evident in the wholesale paper merchants' field, where new, modern warehouses and mechanization for the handling of paper and products have been installed.

These various new developments in manufacturing and distribution facilities, equipment, and techniques have been extended to stepped-up marketing efforts. In many cases, larger budgets for advertising have been established for the year 1954. Sales departments are giving more intensive training to their salesmen and expecting them to be more active than in the past few years when paper was purchased rather than sold. Both mills and wholesale merchants are again offering improved services to their customers, and are willing to meet requests for special qualities or special orders in relatively shorter periods of time.

W. LEROY NEUBRECH, Deputy Assistant Director for Pulp, Paper, and Paperboard—Forest Products Div., U. S. Dept. of Commerce, Washington, D. C.

It is further apparent that with the increase in compe more and more paper, paperboard, and converted pro manufacturers are establishing separate market resear partments in their companies. Such departments ar only analyzing potential new use or new product pote but are at the same time studying market trends by ty consuming outlets. In other words, the industry is foll

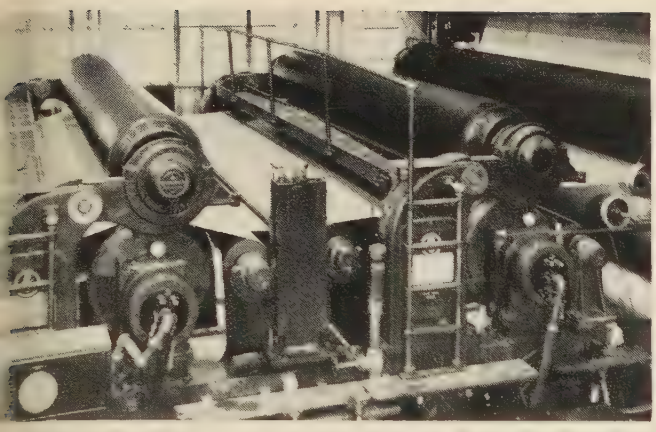
Table I. Statistical Highlights

Item and unit	*1953*	*1952*	*Pe cha*
Pulpwood:			
Receipts, 1000 cords	27,887	27,375	
Consumption, 1000 cords	28,150	26,476	
Inventories, 1000 cords	5,650	5,929	
Wood pulp (total):			
Production, 1000 short tons	17,525	16,473	
Imports, 1000 short tons	2,157	1,937	+
Exports, 1000 short tons	162	212	−
New supply,[a] 1000 short tons	19,520	18,198	
Consumption, total, 1000 short tons	19,481	18,041	
Paper and board, 1000 short tons	18,682	17,286	
Nonpaper, 1000 short tons	799	755	
Inventories, 1000 short tons	741	817	
Pulp, paper and board mills, 1000 short tons	658	711	
Nonpaper mills, 1000 short tons	83	106	−
Market wood pulp (at paper and board mills):			
Receipts, 1000 short tons	2,490	2,276	
Consumption, 1000 short tons	2,500	2,252	+
Inventories, 1000 short tons	380	404	
Market wood pulp (at nonpaper mills):			
Receipts, 1000 short tons	777	783	
Consumption, 1000 short tons	799	755	
Inventories, 1000 short tons	83	106	−
Waste paper:			
Receipts, 1000 short tons	8,426	7,815	
Consumption, 1000 short tons	8,531	7,881	
Inventories, 1000 short tons	479	522	
Paper and board production, total, 1000 short tons	26,566	24,423	
Paper, 1000 short tons	11,387	10,898	
Paperboard, 1000 short tons	12,307	10,772	+
Wet machine, 1000 short tons	155	139	+
Construction paper and board, 1000 short tons	2,718	2,614	
Wholesale paper and paper products:			
Sales, 1,000,000 dollars	2,587	2,461	
Inventories, 1,000,000 dollars	266	255	

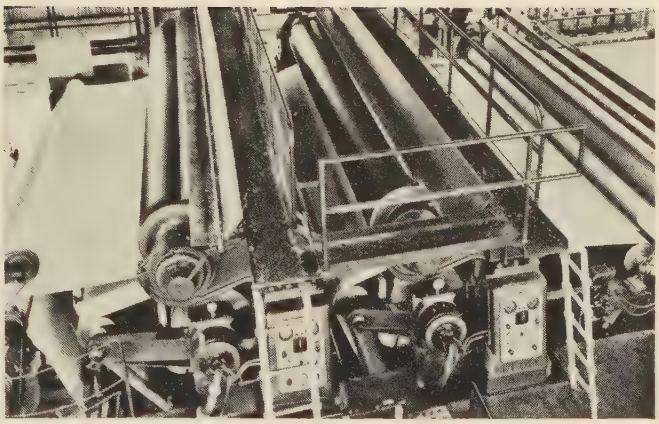
[a] New supply equals production plus imports minus exports.
Source: Prepared by the Forest Products Division, Business and Services Administration, Department of Commerce, based on data fr Bureau of Census and the Office of Business Economics, Departr Commerce.

the pattern established quite a few years ago by a n of other industries, such as automotives and household e appliances, in carefully screening American industri final demand markets for their products.

Additional interest is also being displayed in po foreign markets for American pulp, paper, and paper Substantial dissolving pulp capacity is being developed view toward meeting important foreign needs for th



Courtesy Bagley & Sewall Co.



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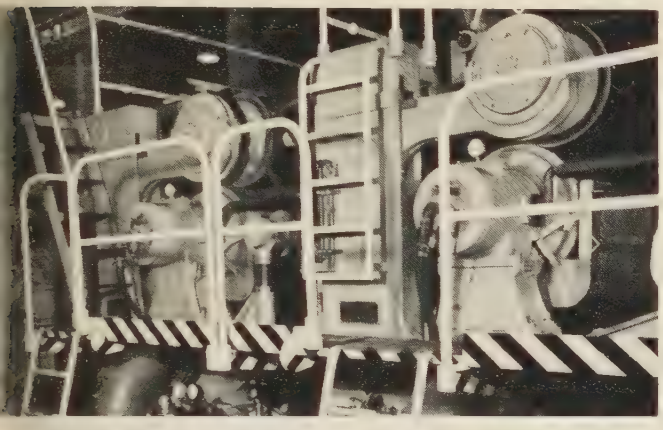

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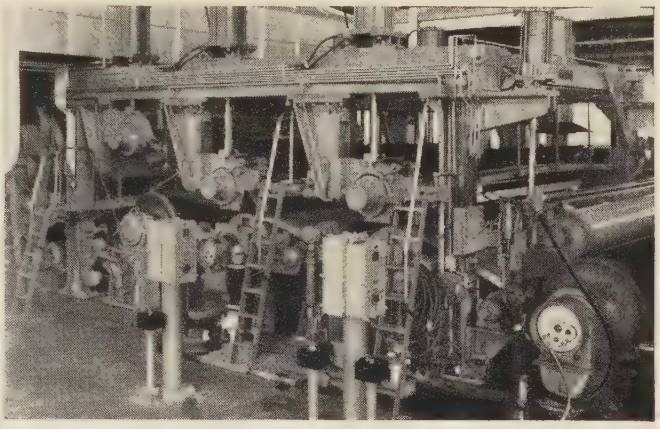

Courtesy Pusey & Jones Corp.

Why Builders and Mills Use TORRINGTON Spherical Roller Bearings In Press Sections

- **Accurate geometrical conformity between races and rollers**—for maximum load bearing capacity at all times.
- **Self-aligning**—for continuous, free-rolling service under shock loads and at sustained speeds.
- **Races and rollers heat treated according to the most advanced metallurgical procedures.**
- **Uniform close control of precision-ground contact surfaces**—for even load distribution and maximum bearing life.
- **Individual one-piece cage for each path of rollers**—assures freedom of operation.
- **Integral center flange on inner race**—to give positive radial and thrust stability—both essential to satisfactory performance.
- **Unit assembly**—for easy, low-cost handling.
- **Available from stock with either straight or tapered bore**—for shaft or adapter mounting.

Specify TORRINGTON Spherical Roller Bearings for your own press sections and other applications in your paper machines.

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Table II. Pulp, Paper, and Board Highlights

Item	Unit, millions of	1953	1952	1951	1950	1949	1948	1947	19
Pulpwood consumption	Cords	28.1	26.5	26.5	23.6	19.9	21.2	19.7	10
Wood pulp production	Tons	17.5	16.5	16.5	14.8	12.2	12.9	11.9	7
Wood pulp consumption[a]	Tons	18.7	17.3	17.7	16.5	13.6	14.4	13.3	8
Waste paper consumption[a]	Tons	8.8	7.9	9.1	8.0	6.6	7.6	8.0	4
Paper and board production	Tons	26.5	24.4	26.0	24.4	20.3	21.9	21.1	13
Wood pulp imports	Tons	2.2	1.9	2.4	2.4	1.8	2.2	2.3	2
Newsprint imports	Tons	5.0	5.0	5.0	4.9	4.6	4.4	4.0	2

[a] In manufacture of paper and board only.
Source: Bureau of the Census, U. S. Department of Commerce.

material, particularly for overseas production of rayon, acetate, transparent film, and other products. This past year a new Webb-Pomerene Corp. was established to incorporate the export interests of several important United States mills for kraft paper and products. Renewed activity is also evident by the two established export committees or associations representing the mills and the export merchants.

The pulp, paper, and paperboard subdivision of the Forest Products Division, U. S. Department of Commerce, is actively assisting the various segments of the industry in both domestic and international trade promotion matters, including assistance in market analysis—current and long-range. More and more emphasis needs to be placed upon the outlook for demand and supply as far ahead as 10, 15, or even 20 years. In this connection, it is interesting to observe that

Table III. Total Value of Sales of the Pulp, Paper, Board, and Products Manufacturing Industry

Year	Millions of dollars	Year	Millions of dollars	Year	Millions of dollars
1939	1785	1944	3629	1949	5448
1940	2064	1945	3725	1950[a]	6976
1941	2836	1946	4469	1951[a]	8477
1942	2965	1947	5764	1952[a]	7979
1943	3389	1948	6060	1953[b]	8701

[a] Revised by Office of Business Economics, December, 1953.
[b] Preliminary.
Source: Office of Business Economics, Department of Commerce. The estimated dollar total of sales represents receipts of all operators of paper manufacturing companies. The figures include data for both corporate and noncorporate businesses but are comparable to the sales data for corporations in Statistics of Income published by the Bureau of Internal Revenue.

many companies are actively projecting their position into the future as a means of judgment on raw material supply and production facilities. More and more weight is being placed upon such economic and statistical projections but of course experience and practical know-how will always be fundamental.

The tendencies of the past to review historical data and then look ahead only a few months or a year or two will continue to be very important, but big companies, as well as small, must keep pace with more intensive economic appraisal or our growing, more complicated industrial and business structure. It will be important for executives in the industry, who attend various meetings and conferences relating to statistics and economic factors affecting the industry as a whole, to bring home to their individual companies these observations and to make similar application to their own companies and their own products.

Table IV. Total United States Imports and Exports Paper Base Stocks, Paper, and Manufactures
(In millions of dollars)

Year	Imports	Exports	Year	Imports	Exports
1939	215	40	1949	666	113
1945	298	102	1950	746	107
1946	419	116	1951	958	231
1947	657	173	1952[a]	925	193
1948	754	139	1953[a]	933	153

[a] Preliminary.
Source: Bureau of the Census, U. S. Department of Commerce.

The ever rising costs of new construction, machinery equipment can only mean increasingly higher capital in ments for new capacity which, coupled with the tre rising wage rates, will not allow for ill-advised capacit pansions. Neither will they allow individual compani maintain their growth and position within the indust they do not take steps toward expansion at the proper in the proper place, and in the proper grades.

Economic analysis from the standpoint of market p tials, capacity, and international competition canno course, be carried on independent of knowledge of the area of technological advances being made throughou

Table V. Annual Value of Sales of United States W sale Distributors of Paper and Its Products. 1939–

Year	Millions of dollars	Year	Millions of dollars	Year	Milli dol
1939	575	1944	878	1949[a]	17
1940	608	1945	909	1950[a]	22
1941	739	1946	1275	1951[a]	2
1942	695	1947	1828	1952[a]	2
1943	823	1948	1902	1953[b]	2

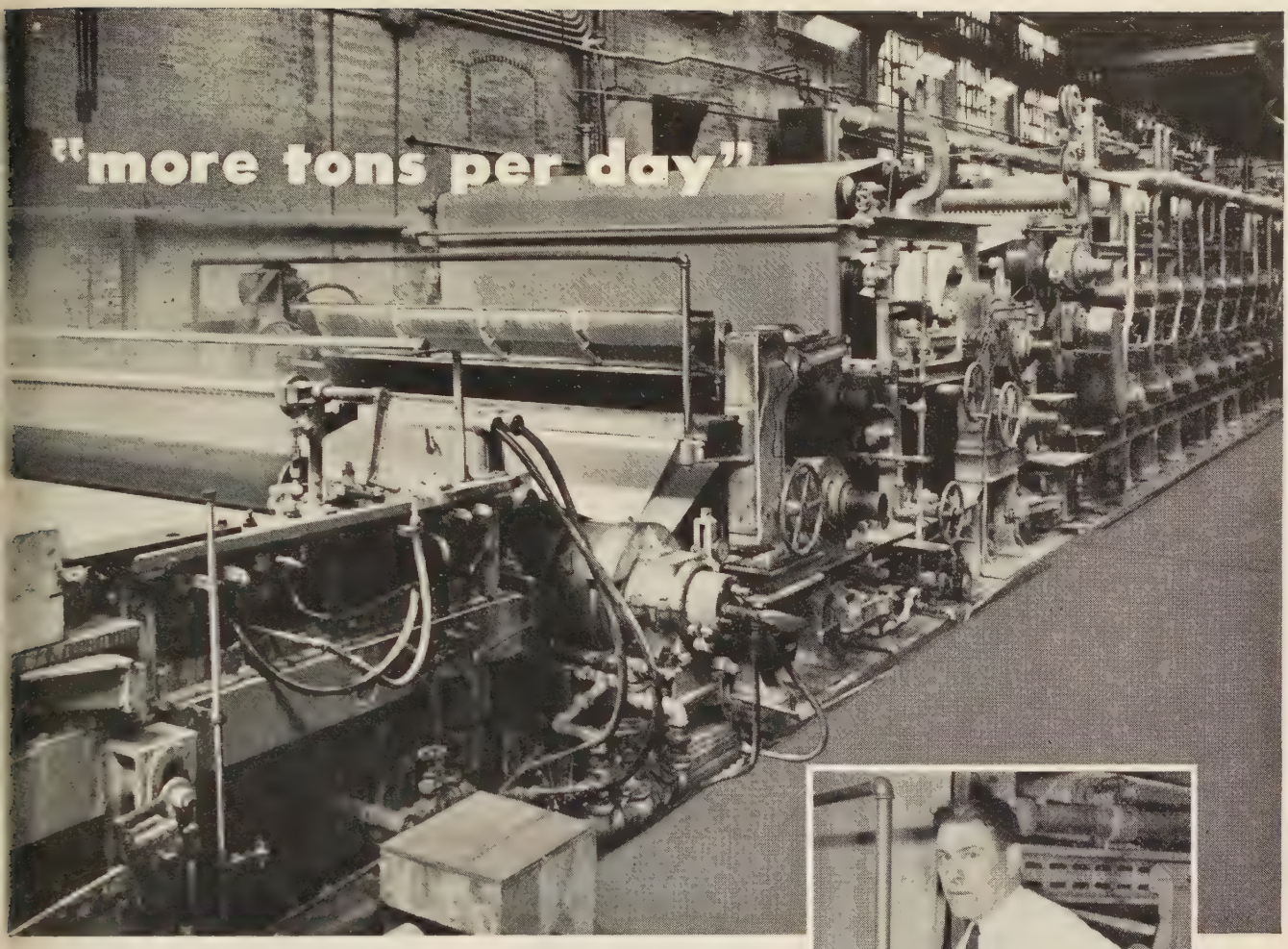
[a] Revised December, 1953. [b] Preliminary.
Source: Office of Business Economics, Department of Commerce.

world. First, there is the matter of forest resources prime raw material of our industry. Developments within the last few years toward hardwood utilizat o various grades of wood pulp, the utilization of sawmil other former waste wood for wood pulp, and the introdu of new pulping processes have changed materially the cu and potential position of the industry as a whole or its co nent segments. The use of new chemicals or organic r rials as additives to impart new and distinct qualities to and paperboard are opening new vistas for applicatio uses where wet strength and other qualities are ne These new use applications will make it possible for the i try to witness a continued increase in the per capita cons tion of paper and paperboard.

Table VI. Monthly Value of Sales of United S Wholesale Distributors of Paper and Its Products, 19
(Millions of dollars)

Month	1953[a]	1952	1951	1950	1949	1948
January	210	213	258	153	148	163
February	192	198	223	152	136	152
March	220	207	243	166	148	159
April	216	208	222	160	137	157
May	205	198	236	169	131	151
June	200	185	226	185	139	161
July	216	185	198	175	125	144
August	233	201	232	219	152	163
September	235	221	202	212	152	166
October	232	234	242	231	154	169
November	216	203	215	224	155	162
December	212	208	181	215	146	155
Total	2587	2461	2678	2266	1723	1902

[a] Preliminary.
Note: These data revised by Office of Business Economics, Dec 1953.
Source: Office of Business Economics, U. S. Department of Comm



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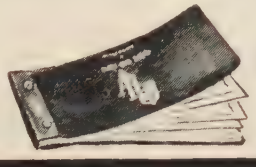

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Table VII. Pulpwood—United States Annual Receipts, Imports, Consumption, and Inventories, 1942–53

(1000 standard cords—roughwood basis)

Item	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1
Receipts, total	27,887	27,375	27,778	22,546	19,266	22,333	20,619	18,978	16,982	16,999	15,292	17
Domestic	26,339	25,065	25,128	20,712	17,619	20,026	18,542	16,932	15,253	15,349	13,580	14
Imported	1,548	2,310	2,650	1,834	1,647	2,307	2,077	1,996	1,729	1,650	1,712	2
Northeast, total	3,832	4,549	4,723	3,295	3,275	4,039	4,135	3,650	3,389	3,039	2,953	3
Domestic	2,807	3,250	3,137	2,235	2,366	2,666	2,970	2,508	2,311	1,976	1,906	2
Imported[b]	1,025	1,300	1,586	1,060	909	1,373	1,165	1,142	1,078	1,063	1,047	1
Appalachian, total	1,870	1,630	1,960	1,705	1,544	1,784	1,623	1,716	1,388	1,482	1,304	1
Domestic	1,870	1,630	1,960	1,705	1,544	1,763	1,610	1,684	1,365	1,472	1,302	1
Imported[b]	....	....	....	....	....	21	13	32	23	10	2	
Lake States, total	2,762	3,228	3,425	2,472	2,149	3,031	2,900	2,919	2,456	2,638	1,969	2
Domestic	2,239	2,459	2,622	1,985	1,619	2,344	2,154	2,239	1,954	2,175	1,409	1
Imported	523	768	803	487	530	687	746	680	502	463	560	
South, total	14,959	13,382	12,844	11,543	9,060	9,997	8,227	7,909	7,153	7,090	6,505	6
Domestic	14,959	13,382	12,844	11,543	9,060	9,997	8,227	7,909	7,153	7,090	6,505	6
West, total	4,463	4,586	4,826	3,531	3,238	3,482	3,734	2,784	2,596	2,750	2,561	2
Domestic	4,463	4,344	4,565	3,244	3,030	3,256	3,581	2,642	2,470	2,636	2,458	2
Imported[b]	....	241	261	287	208	226	153	142	126	114	103	
Consumption, total	28,150	26,476	26,522	23,627	19,945	21,189	19,714	17,818	16,913	16,758	15,645	17
Northeast	3,848	4,047	4,280	3,704	3,397	3,814	3,740	3,466	3,245	3,159	3,265	3
Appalachian	1,822	1,673	1,859	1,796	1,614	1,767	1,684	1,501	1,444	1,490	1,442	1
Lake States	3,036	2,925	3,039	2,825	2,461	2,821	2,724	2,554	2,544	2,474	2,325	2
South	14,752	13,320	12,854	11,480	9,255	9,443	8,395	7,516	7,208	7,153	6,342	6
West	4,692	4,511	4,490	3,822	3,218	3,344	3,171	2,781	2,472	2,482	2,271	2
Inventories, total	5,650	5,929	5,072	3,815	4,905	5,622	4,566	3,780	2,626	2,819	2,846	3
Northeast	1,665	1,937	1,483	1,051	1,520	1,644	1,442	1,063	869	700	820	1
Appalachian	370	323	367	249	332	397	372	422	206	279	280	
Lake States	1,418	1,693	1,380	986	1,343	1,674	1,487	1,350	986	1,088	962	1
South	1,089	856	772	753	670	828	291	526	145	218	293	
West	1,108	1,120	1,070	776	1,040	1,079	974	419	420	534	491	

[a] Preliminary. [b] Imports to Appalachian and West regions included in Northeast to avoid disclosure of individual company data.
Note: Detail may not add to totals because of rounding.
Sources: Prepared by the Forest Products Division—Business and Defense Services Administration. Data covering 1942-44, inclusive—Forest Prod Bureau, War Production Board; data covering 1945–53, inclusive—Bureau of the Census, U. S. Department of Commerce.

Table VIII. Wood Pulp—United States Annual Imports and Exports, 1943–53

(1000 short tons)

Item	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	19
Imports, total	2157	1937	2361	2385	1763	2176	2322	1805	1754	1072	13
Bleached sulphite: Rayon and special chemical grades	256	223	231	239	154	235	249	202	146	133	1
Bleached sulphite: Other	332	277	349	402	331	323	288	223	242	188	2
Unbleached sulphite	381	432	557	529	392	675	732	618	657	399	5
Bleached sulphate	591	519	522	450	392	278	239	80	72	47	
Unbleached sulphate	292	208	336	440	249	336	470	398	380	99	1
Soda	35	28	33	34	27	25	21	20	21	16	
Chemical screenings	7	4	10	5	3	8	10	9	7	7	
Bleached mechanical	65	34	18	20	1	...	...	1	1	[b]	
Unbleached mechanical	194	208	300	260	208	291	309	249	222	177	2
Mechanical screenings	4	4	5	6	6	5	5	6	5	5	
Exports, total	162	212	200	96	122	94	130	39	135	218	3
Bleached sulphite: Rayon and special chemical grades	69	65	31	28	25	18	11	8	13	11	
Bleached sulphite: Other	18	24	44	18	20	13	44	7	17	38	
Unbleached sulphite	31	35	44	33	39	54	54	17	27	46	
Bleached sulphate	13	12	9	5	9	1	2	1	6	7	
Unbleached sulphate	29	75	69	9	27	6	17	5	60	106	1
Soda	2[c]	1[c]	1	[b]	[b]	1	1	[b]	11	11	
Screenings and other wood pulp	...	...	2	2	1	1	2	1	1	[b]	

[a] Preliminary. [b] Less than 500 tons. [c] Includes "screenings and other wood pulp."
Note: Detail may not add to total because of rounding.
Source: Bureau of the Census, U. S. Department of Commerce.

Table IX. Total United States Annual Wood Pulp Imports, All Grades—by Major Countries of Origin

(1000 short tons)

Country	1953[a]	1952	1951	1950	1949	1948	1947	1946	1
Total	2157	1937	2361	2385	1763	2176	2322	1805	1
Canada[b]	1614	1578	1877	1717	1314	1601	1529	1245	1
Sweden	335	190	258	398	266	385	555	445	
Finland	160	145	183	206	149	176	224	115	
Norway	37	21	36	29	29	13	10	...	
All other	11	3	7	35	5	2	5	...	

[a] Preliminary. [b] Includes Newfoundland.
Note: Detail may not add to totals because of rounding.
Source: Prepared by the Forest Products Division—Business and Defense Services Administration, based upon data from the Bureau of the Census, Department of Commerce.

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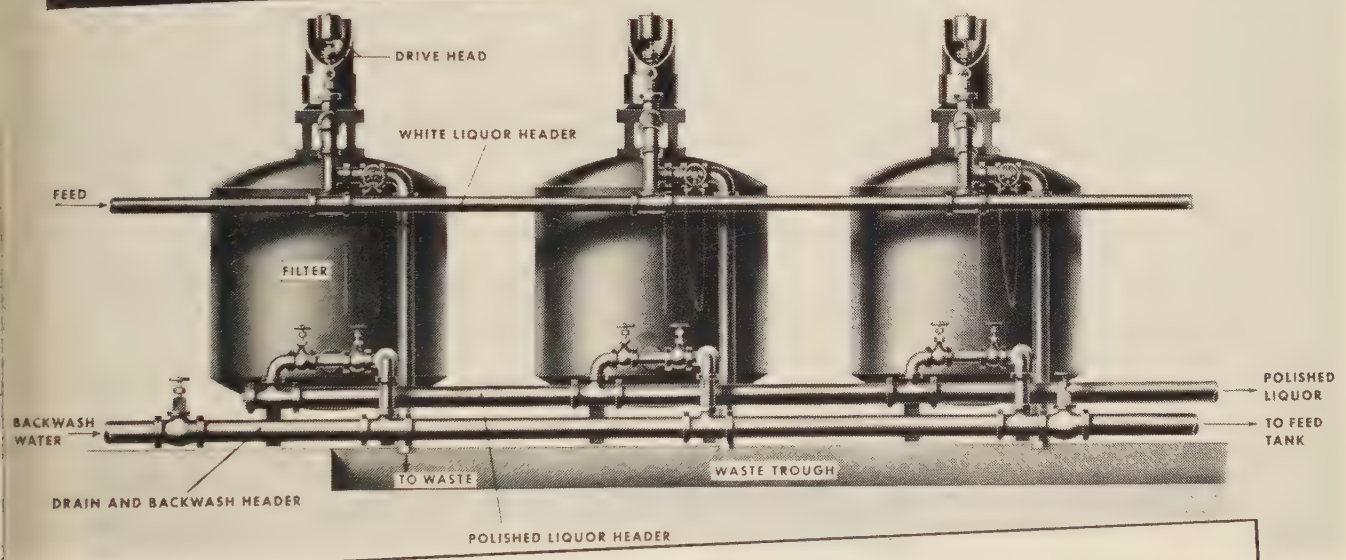
The DORRCO White Liquor Polishing Station

Designed to fit in as an integral part of new or existing Dorr Continuous Recausticizing Systems, the White Liquor Polishing Station consists of one or more vertical pressure filters and all necessary piping, valves and control instruments. While this development is of particular importance to producers of bleached and dissolving pulps, the assurance of a cooking liquor of uniform purity and clarity is of interest to every producer in terms of better overall operation.

For further information on the Dorrco White Liquor Polishing Station, write The Dorr Company, Stamford, Conn., or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.



Facts on the DORRCO White Liquor Polishing Station

- Filtering medium of graded anthracite coal entraps colloidal material too fine to be removed economically by gravity.
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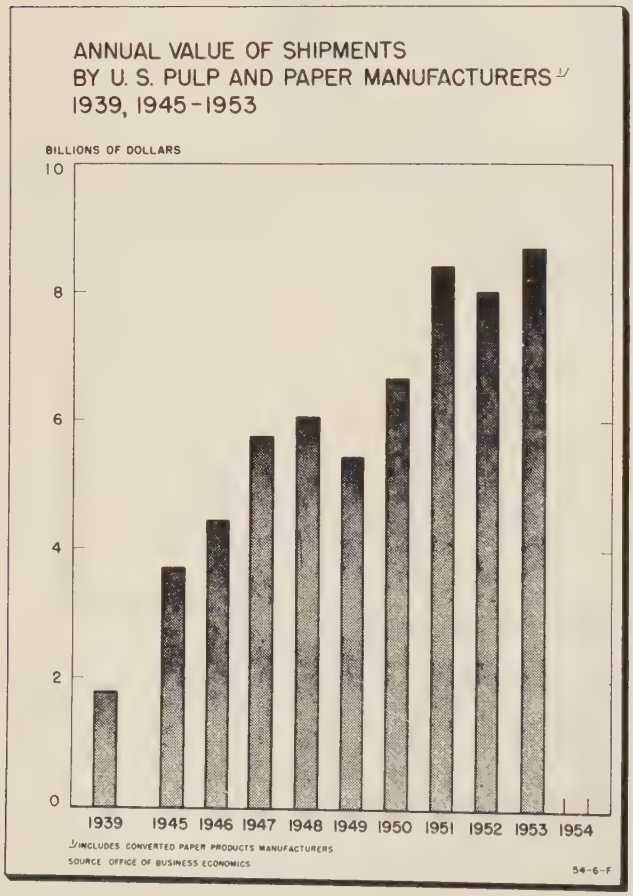
Table X. Wood Pulp—United States Annual Production and Domestic Consumption in Paper and Board Manufact

(1000 short tons)

Item	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	19
Production, total	17,525	16,473	16,524	14,849	12,207	12,872	11,946	10,607	10,167	10,108	9680	10,783	10,
Special alpha and dissolving	677	706	616	479	374	[b]	[b]	[b]	[b]	[b]	[b]	[b]	
Sulphite, total[c]	2,321	2,365	2,525	2,370	2,162	2,811	2,796	2,476	2,360	2,386	2437	2,930	2,
Bleached[c]	1,727	1,692	1,761	1,629	1,455	1,909	1,902	1,692	1,544	1,523	1553	1,717	1,
Unbleached	594	673	764	741	707	902	894	784	816	863	883	1,213	1,
Sulphate, total	9,435	8,569	8,572	7,502	5,977	6,014	5,357	4,588	4,472	4,549	4236	4,738	4,
Bleached	2,379	2,083	1,899	1,433	1,118	1,040	909	750	705	665	602	653	
Semibleached	303	275	294	360	264	225	193	152	149	144	147	159	
Unbleached	6,753	6,211	6,379	5,709	4,595	4,749	4,255	3,686	3,618	3,740	3487	3,927	3,
Soda	428	425	446	522	492	510	492	476	430	413	419	462	
Groundwood	2,379	2,380	2,474	2,216	1,961	2,175	2,050	1,897	1,696	1,639	1638	1,756	1,
Defibrated, exploded, etc.	1,116	1,059	945	935	604				691	663	627	520	
Semichemical	1,029	829	797	686	506	1,362	1,252	1,169					
Screenings, damaged, etc.	140	140	150	140	130				519	459	324	377	
Consumption, total	18,682	17,286	17,737	16,509	13,636	14,375	13,252	12,092	10,825	10,502	10,635	11,038	11,
Special alpha and dissolving	56	71	52	40	26	[b]	[b]	[b]	[b]	[b]	[b]	[b]	
Sulphite, total[c]	3,012	2,971	3,240	3,276	2,986	3,333	3,229	3,144	2,583	2,519	2892	3,079	3,
Bleached[c]	2,068	1,944	2,037	2,029	1,825	1,856	1,792	1,680	1,346	1,277	1442	1,498	1,
Unbleached	944	1,027	1,203	1,247	1,161	1,477	1,437	1,465	1,237	1,242	1449	1,581	1,
Sulphate, total	10,279	9,136	9,310	8,381	6,678	6,663	5,860	5,141	4,680	4,588	4430	4,633	4,
Bleached	2,907	2,500	2,383	1,862	1,484	1,305	1,068	833	756	714	683	667	
Semibleached	373	308	330	389	277	251	199	184	168	156	163	164	
Unbleached	6,999	6,328	6,597	6,130	4,916	5,107	4,594	4,124	3,756	3,719	3584	3,802	3,
Soda	504	461	484	559	526	521	520	492	440	418	456	469	
Groundwood	2,558	2,610	2,752	2,433	2,184	2,482	2,328	2,133	1,905	1,830	1855	1,926	2,
Defibrated, exploded, etc.	1,107	1,064	944	932	602	742			684	661	639	527	
Semichemical	1,021	828	797	635	502	149	1,315	1,181					
Screenings, damaged, etc.	144	144	159	153	131	485			533	486	364	404	

[a] Preliminary. [b] Included in "bleached sulphite" for 1941–48. [c] Includes "special alpha and dissolving" for 1941–48.
Note: Detail may not add to totals because of rounding.
Source: Bureau of the Census, U. S. Department of Commerce.



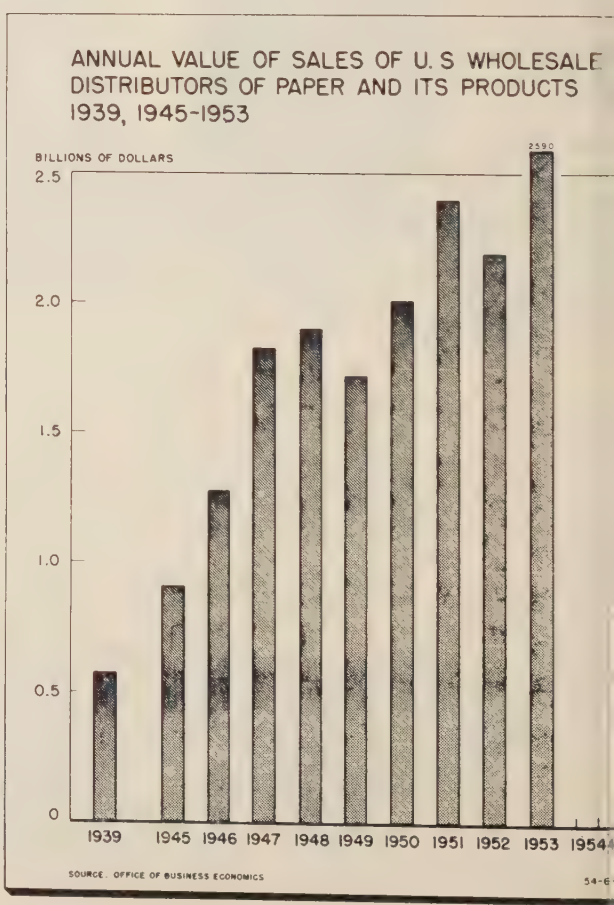


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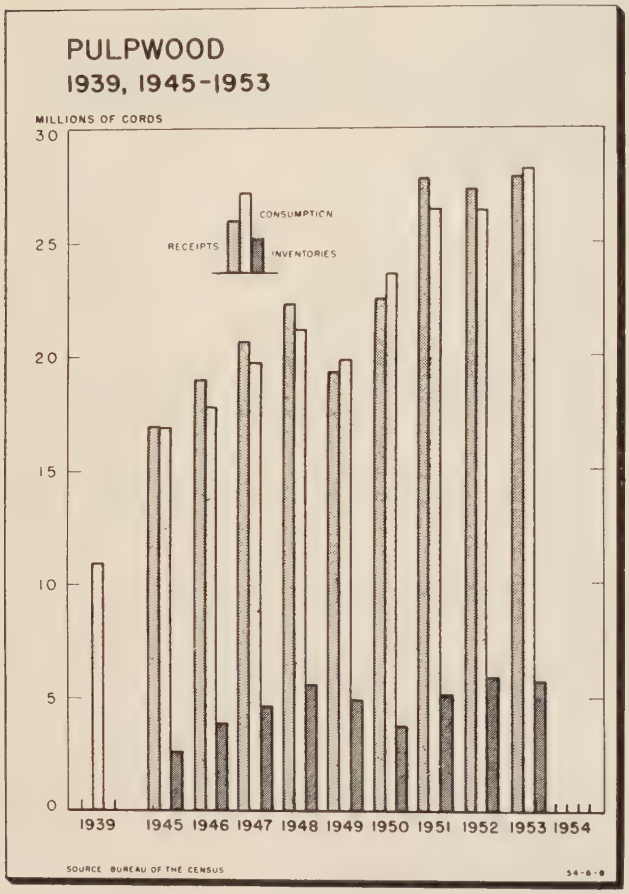
Table XI. Wood Pulp—Year-End Inventories, Pulp, Paper, and Board Mills Only, 1943–53
(1000 short tons)

Item	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	19
Wood pulp, total	658	711	611	492	512	710	710	490	555	333	4
Special alpha and dissolving	54	63	24	15	29	[b]	[b]	[b]	[b]	[b]	
Sulphite, total[c]	229	256	239	193	238	370	369	232	299	196	2
Bleached[c]	115	120	112	86	100	157	163	107	127	152	1
Unbleached	114	136	127	107	138	213	206	125	173	44	
Sulphate, total	292	298	231	197	147	226	244	176	179	66	
Bleached	181	166	114	108	69	67	65	36	39	22	
Semibleached	15	11	8	5	5	7	7	4	6	5	
Unbleached	96	121	110	84	73	152	171	135	135	39	
Soda	17	16	16	11	15	24	22	17	12	16	
Groundwood	53	63	85	70	65	74	63	56	53	41	
Miscellaneous	13	15	17	7	17	16	13	9	12	14	

[a] Preliminary. [b] Included in "bleached sulphite" for 1943–48. [c] Includes "special alpha and dissolving" for 1943–48.
Source: Bureau of the Census, U. S. Department of Commerce (figures for 1945–48); Forest Products Bureau, WPB (figures for 1943–44).



Translating tonnage production figures of the pulp, pa
board, and products industry for 1953 into value disclos
record breaking output of $8701 million. This comp
with $7979 million in 1952 and $8477 million in 1951.

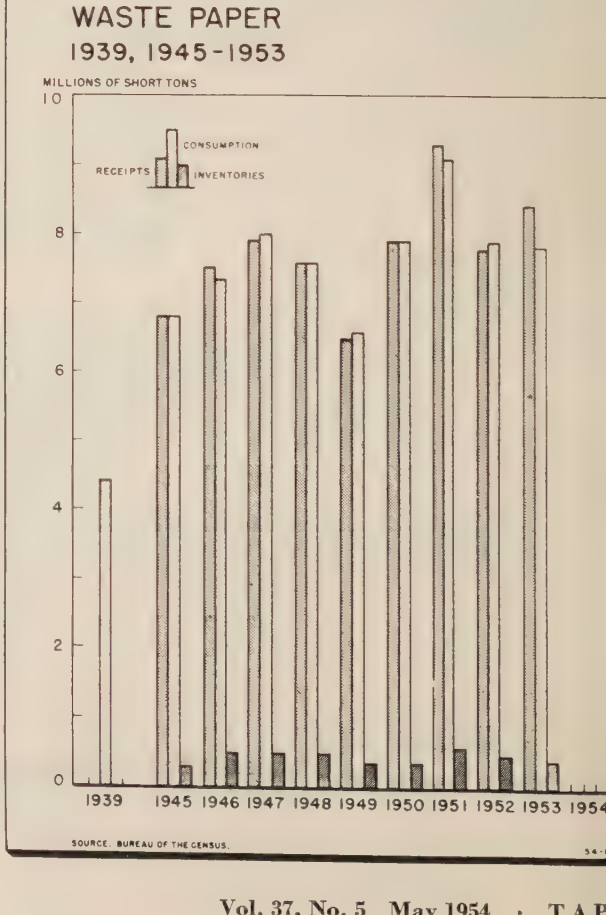
Both the production and consumption of wood pul
1953 established all-time records. Imports of wood p
on the other hand, while somewhat greater than in 1952, w
materially below the volume of imports in many former ye

Consumption of market wood pulp, at 2,500,000 t
showed a substantial gain over 1952, but was under 19
when market demands absorbed near-capacity productio
most of the smaller nonintegrated paper and paperboard m
The year 1953 might be said to be a normal or average yea
operation for the mills depending upon purchased wood p
As brought out in a special study on market pulp, which
peared in the December, 1952, issue of the "Pulp, Paper
Board Industry Report," the past 20-year range in ma
wood pulp consumption in the United States by paper
paperboard nonintegrated or partially integrated mills
been from about 2,200,000 to 2,900,000 tons, with a m
average for this period being about 2,500,000 tons.

Table XII. Wood Pulp in Other Than Paper and Board Manufacture, 1951–53
(1000 short tons)

	1953[a]	1952	1951
Receipts, total	777	783	730
Special alpha and dissolving	690	705	n.a.
All other	87	78	n.a.
Domestic, total	545	560	488
Special alpha and dissolving	485	502	n.a.
All other	60	58	n.a.
Imports from Canada,[b] total	232	223	242
Special alpha and dissolving	205	203	n.a.
All other	27	20	n.a.
Consumption, total	799	755	714
Special alpha and dissolving	713	676	n.a.
All other	86	79	n.a.
Inventories, year-end, total	83	106	78
Special alpha and dissolving	77	101	72
All other	6	5	6

[a] Preliminary. [b] Includes a small quantity from overseas.
n.a. Not available.
Source: Bureau of the Census, Department of Commerce.



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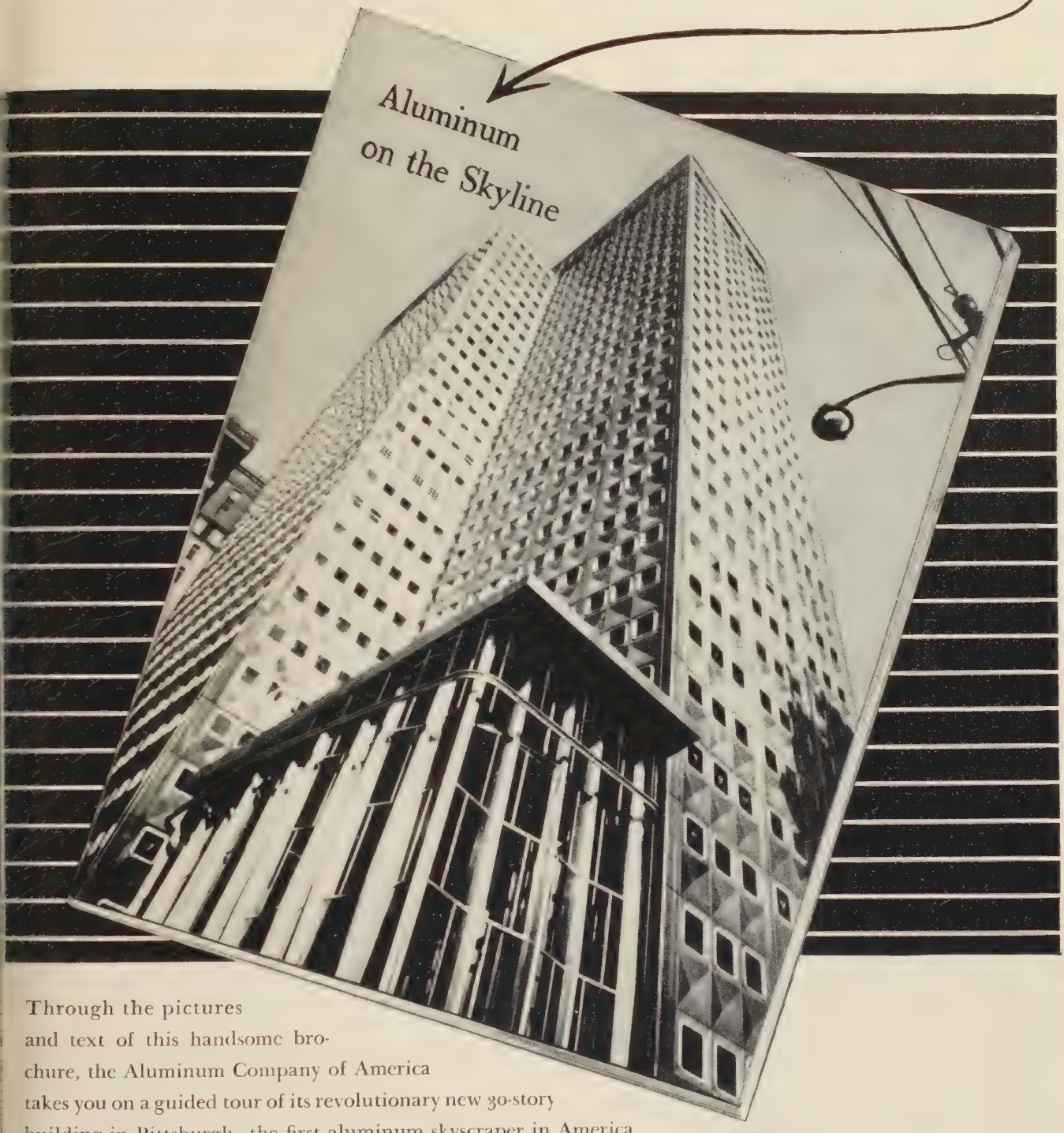

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Table XIII. Market Wood Pulp[a]—Paper and Paperboard Mills Only—Annual Receipts, Consumption, and Inventor 1947–53

(1000 short tons)

Item	1953	1952	1951	1950	1949	1948	1
Wood pulp, total all grades:							
Receipts, total	2490	2276	2819	2916	2152	2571	27
Domestic	1155	1120	1297	1213	938	1060	11
Imported	1355	1156	1522	1703	1214	1511	15
Canada and Newfoundland	819	846	1054	976	707	917	7
European	516	310	468	727	507	594	7
Consumption (purchased pulp) total	2500	2252	2742	2902	2325	2586	2
Inventories (purchased pulp) total	380	404	395	332	342	519	5
Domestic shipments, total[b]	1087	1059	1254	1147	905	1024	10
Sulphite, all grades:							
Receipts, total	1107	1139	1398	1466	1209	1474	15
Domestic	563	595	702	672	588	649	7
Imported	544	544	696	794	621	825	8
Canada and Newfoundland	336	402	498	480	370	525	4
European	208	142	198	314	251	300	3
Consumption, total	1137	1112	1362	1484	1313	1455	14
Inventories, total	179	213	202	163	194	297	2
Domestic shipments[b]	489	563	720	655	576	642	6
Sulphate, all grades:							
Receipts, total	1029	775	947	1003	614	714	7
Domestic	445	351	398	325	187	200	2
Imported	584	424	549	678	427	514	5
Canada and Newfoundland	333	281	318	301	208	236	1
European	251	143	231	377	219	278	3
Consumption, total	1003	769	919	973	666	720	7
Inventories, total	164	140	141	120	102	158	1
Domestic shipments[b]	438	339	362	291	181	199	2
Groundwood and other grades:							
Receipts, total	354	361	474	445	329	383	3
Domestic	147	173	197	216	163	211	2
Imported	207	188	277	229	166	172	1
Canada and Newfoundland	150	163	238	187	129	156	1
European	57	25	39	42	37	16	
Consumption, total	350	373	461	442	346	411	3
Inventories, total	37	51	52	49	46	64	
Domestic shipments[b]	160	156	172	201	148	183	1

[a] Market pulp consists of domestic or imported pulp purchased from a mill not under the same ownership control as the purchaser.
[b] Shipments by domestic pulp mills to domestic paper and paperboard mills. The difference between shipments and receipts may be explained in part by "transit" pulp and probable incomplete reports on domestic shipments.

Wood pulp exports for 1953 showed a noticeable decline following pent-up foreign demands existing in 1950, 1951, and the first part of 1952. Pulp exports in 1953 totaled only 162,000 tons, compared to 212,000 tons in 1952.

Production Workers and Wages, Pulp, Paper, and Allied Products Industries

Year	Average number of wage earners, thousands	Total dollar wages, millions	Year	Average number of wage earners, thousands	Total dollar wages, million
1899	94	36	1948	394	1063
1909	145	68	1949	382	1111
1919	208	213	1950	404	1284
1929	233	287	1951	420	1436
1939	265	310	1952	422	1514
1947	391	953	1953[a]	444	1683

[a] Preliminary.
Source: Prepared by the Forest Products Division, Business and Defense Services Administration, based on data furnished by the Bureau of Labor Statistics, Department of Labor.

Waste paper consumption showed a notable rise in 1953 over 1952, somewhat proportionate to the increase in the various grades of container board and folding setup boxboard. However, 1953 consumption of waste paper was still about 500,000 tons less than in 1951. Although waste paper consumption is not keeping pace with the rapid growth in wood pulp consumption, it will nevertheless continue an upward trend for some time to come, as it represents an important raw material in the manufacture of box boards, as well as a number of grades of paper. With consumption of waste paper in recent years ranging around 8 to 9 million tons, it cannot be overlooked as a major raw material of the industry. Furthermore, as the consumption of paper a paperboard continues to grow, there will be an increas volume of waste paper for use.

It has been said that waste paper represents in a sens "secondary forest." The renewed efforts of the indust through the establishment of its Waste Paper Utilizat Council, to solve some of the intrinsic technological proble in using waste paper, coupled with supply and distribut factors, are to be commended. The Council, working cooperation with other existing waste paper trade grou should, over a period of time, achieve notable results.

As employers of labor, the pulp, paperboard, and all products industries continue to add to their product workers so that in 1953 over 444,000 wage earners were e ployed, with wages totaling $1683 million.

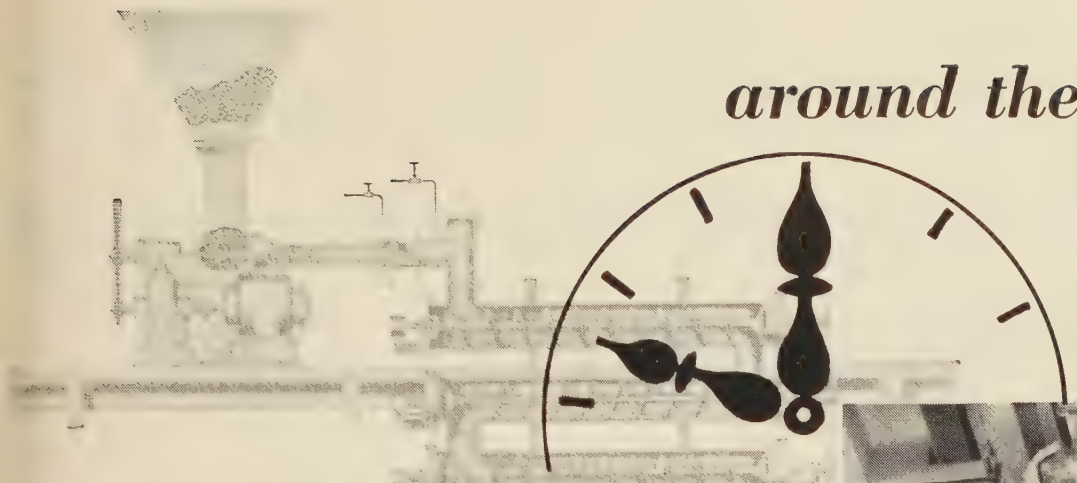
The importance of wholesale paper merchants as a distri tion branch of the industry must be properly recognized. E though a large part of the industry's products are sold di to converters, to manufacturers of other products, or large printers, nevertheless in 1953 over $2587 million paper and products was handled by wholesale paper m chants throughout the United States. This would indic that approximately 30% of the total value of produ produced by the industry traveled through the hands wholesale paper merchants.

In the field of foreign trade, the industry is a major fac Imports in 1953, especially of pulpwood, wood pulp, and ne print, totaled $933 million, while exports of pulp, paper, products amounted to $153 million.

PULPWOOD

The forests of North America supply the fundamental material of the industry. The rate of growth of pulpw

around the clock



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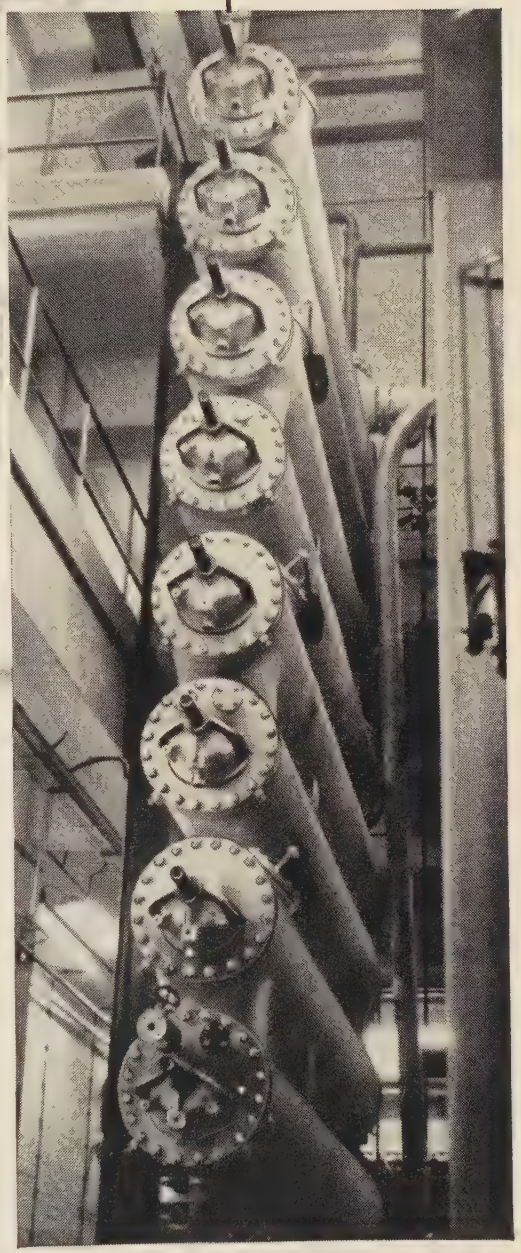
continuous digester



More and more mills using CHEMI-PULPER Continuous Digesters for their around-the-clock operation report the continuous production of uniform, high grade pulps at the lowest possible cost.

Over 90 CHEMI-PULPER Continuous Digesters, built in multiples ranging from 2 to 8 tubes with various diameters, are operating in the United States and foreign countries, producing many grades of pulps from a wide variety of raw materials.

Wood chips or other cellulosic materials are fed to the CHEMI-PULPER tubes by a PANDIA Screw Feeder, moved through the tubes by conveyor screws, and cooked under pressure. Cooking liquor can also be introduced and circulated for those processes where it is required. A PANDIA Discharger then discharges the material continuously and uniformly to the atmosphere. Within this apparatus, the cooking process itself is most flexible. Production rate, cooking time, pressure, etc. can all be altered in a matter of a few minutes with the result that within half an hour an entirely different type of product can be obtained.

The CHEMI-PULPER Continuous Digester is the ideal equipment not only for cooking wood chips, but also for pretreatment processes, cooking of cotton linters, corn cobs, flax, bagasse, etc. The CHEMI-PULPER Continuous Digester has, in fact, proved itself adaptable to almost any pressure cooking process.

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Table XIV. Waste Fibrous Materials—United States Annual Receipts, Consumption, and Inventories

(1000 short tons)

Item	*1953*[a]	*1952*	*1951*	*1950*	*1949*	*1948*	*1947*	*1946*	*1945*	*1944*[b]	*1943*[a]	*19*
Receipts, total	9768	9045	10,715	9399	7759	9120	9434	8895	8194	8359	7224	[c]
Waste paper	8426	7815	9,252	7964	6522	7605	7875	7487	6824	6937	6067	[c]
Rags	320	318	396	440	378	407	445	427	392	431	404	[c]
Other	1022	912	1,067	995	859	1108	1114	981	978	991	753	[c]
Consumption, total	9785	9092	10,528	9395	7815	9036	9535	8661	8143	8244	7564	552
Waste paper	8531	7881	9,071	7956	6600	7584	8009	7278	6800	6859	6368	436
Rags	325	325	389	442	382	416	462	403	414	428	426	46
Other	929	886	1,068	997	833	1036	1064	980	929	957	770	69
Inventories, total	1083	1095	1,163	966	998	1129	1087	1078	840	837	533	[c]
Waste paper	479	522	589	387	397	517	521	515	327	315	249	[c]
Rags	59	54	61	54	56	58	67	77	53	79	71	[c]
Other	555	519	513	525	545	554	499	486	460	443	213	[c]

[a] Preliminary.
[b] 1944 receipts and inventories and data for 1943 were reported by a few mills other than paper and paperboard mills. Data for the remaining years are paper and paperboard mills only.
[c] Not available.
Source: Bureau of the Census, U. S. Department of Commerce, and Forest Products Bureau, War Production Board.

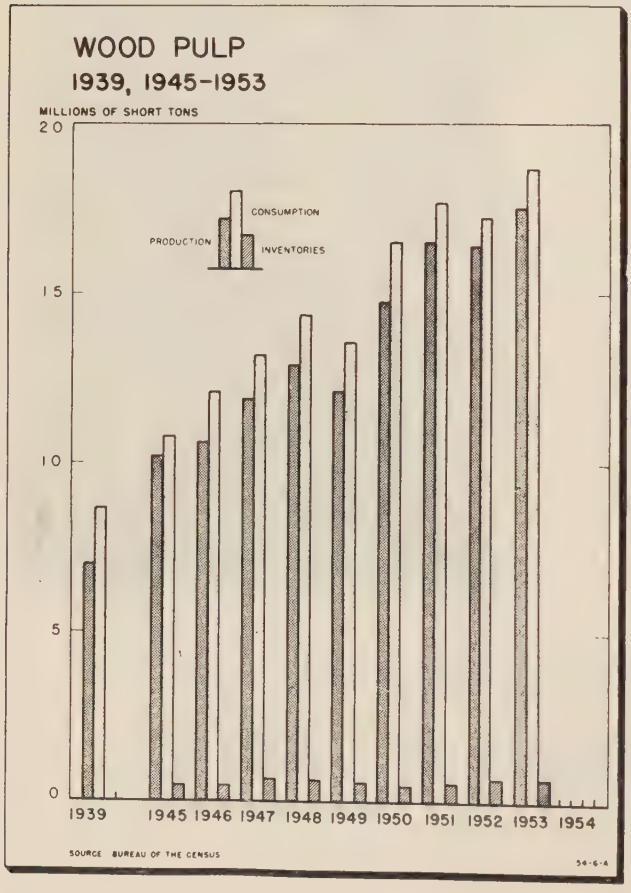
consumption has even been greater proportionately than the increase of the production of its end products. This has been brought about by the greater use of wood pulp as related to secondary fibers, such as waste paper, rags, and straw. In 1953 total consumption exceeded 28 million cords, of which about a million and a half cords were imported—the balance being of domestic origin.

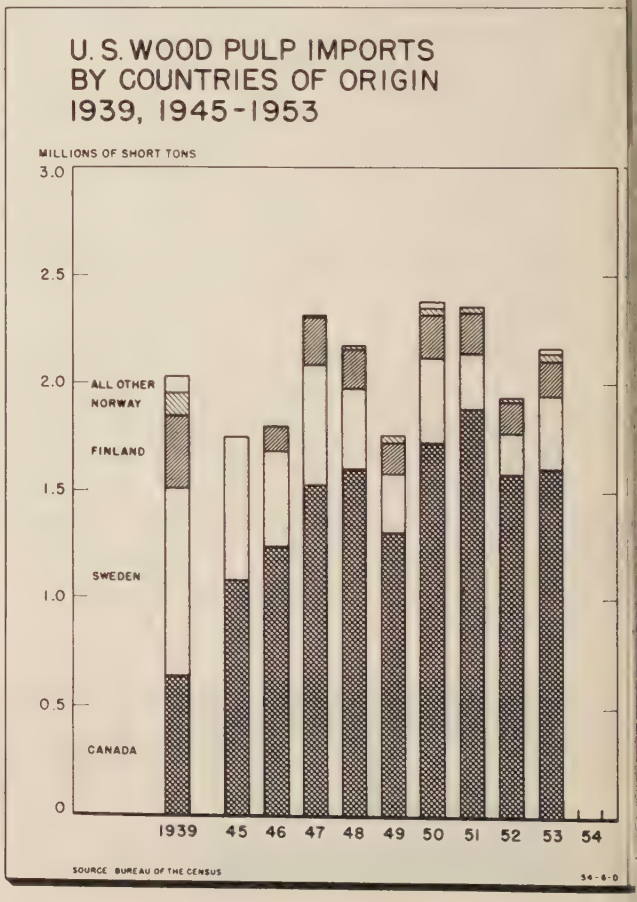
Particularly noteworthy has been the growth of pulpwood consumption in the southern region, which in 1953 totaled 14.8 million cords compared with 6.3 million cords in 1943. The pulp and paper industry in large part has been responsible for the economic application of forestry to timberlands to the extent that the growing of timber for pulpwood under the principles of forestry management, together with insect and fire control, has proved profitable from a private investment point of view. Of course it must not be overlooked that other wood-using industries also are doing their part toward forestry, conservation, and utilization of American fores

As mentioned previously, the pulp, paper, and board dustry as a whole is fostering measures aimed at increas utilization of former waste wood from logging operations well as from sawmills and other primary wood-using ind tries. The developments on the West Coast in this dir tion during the past decade are rapidly being applied in t South, the Northeast, and in the Lake States. Also, t growing use of hardwoods in wood pulp production is grea aiding over-all forestry practices directed toward maintaini sustained yield of timber raw material for wood pulp and otl wood products.

WOOD PULP

Trends in wood pulp production through 1953 disclose t rapid growth particularly evident in semichemical and fibrated exploded grades. It is in this field where a la





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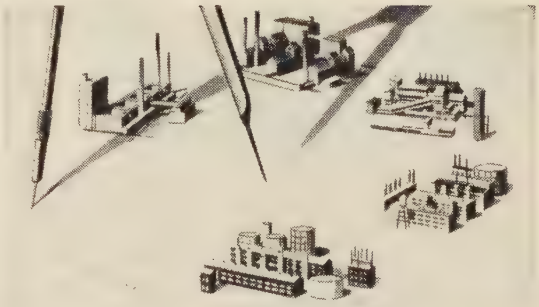

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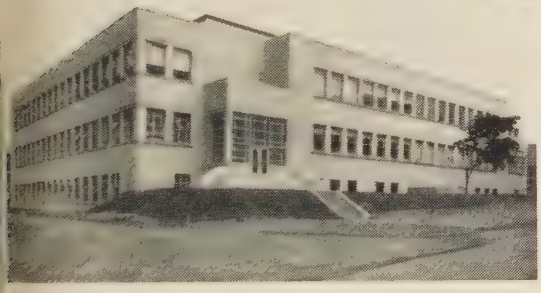

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Table XV. Paper and Paperboard—United States Production, 1943–53

(1000 short tons)

Type of product	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	19
All types	26,566	24,423	26,048	24,375	20,316	21,897	21,114	19,278	17,371	17,183	17,0
Paper, total	12,705	12,197	13,011	12,064	10,349	11,119	10,705	9,788	8,457	8,220	8,4
Newsprint	1,065	1,109	1,108	1,013	918	876	833	773	725	721	8
Groundwood	782	806	791	705	674	772	821	776	636	593	5
Printing	593	589	519	488	484	538	546	474	351	314	3
Converting and other	189	217	172	217	190	234	275	302	285	279	2
Machine coated paper	1,182	1,096	1,113	1,020	887	809	627	486	334	305	3
Book paper	1,630	1,482	1,610	1,579	1,416	1,570	1,581	1,447	1,167	1,131	1,2
General printing	1,022	959	1,035	1,008	926	1,067	1,070	972	777	729	8
Converting	590	513	558	557	476	485	498	457	380	400	4
Other book paper	18	10	18	14	14	18	13	18	10	2	
Fine paper	1,280	1,295	1,366	1,199	1,015	1,141	1,172	1,160	1,001	974	1,0
Writing paper	1,016	1,052	1,093	958	806	909	918	902	811	777	8
Rag	124	132	161	138	120	138	174	176	191	118	1
Chemical wood	892	920	932	820	686	771	744	726	620	659	6
Cover and text	64	59	63	61	63	72	93	93	59	52	
Bristols	110	106	109	102	79	88	87	97	67	84	
Thin paper[b]	90	78	101	78	67	72	73	68	63	61	
Coarse paper, total	3,422	3,238	3,627	3,298	2,758	3,027	2,903	2,690	2,403	2,314	2,2
Glassine, greaseproof and vegetable parchment	151	138	177	162	141	151	156	158	140	139	1
Wrapping	640	651	705	713	692	726	667	763	715	650	6
Bag paper	869	797	838	754	690	736	540	524	365	375	5
Shipping sack	781	753	849	748	510	567	671	550	423	392	3
Converting	981	899	1,057	921	725	847	869	695	760	758	5
Special industrial paper	411	396	408	341	248	308	289	272	238	245	2
Sanitary paper	1,255	1,148	1,244	1,148	1,008	983	894	861	824	808	8
Tissue paper	233	209	229	217	187	205	195	184	157	158	1
Absorbent paper	128	118	128	119	86	107	100	103	89	90	
Building paper and insulation	1,317	1,298	1,386	1,425	1,151	1,321	1,289	1,036	883	881	8
Board, all types, total	13,861	12,226	13,037	12,311	9,967	10,778	10,409	9,490	8,914	8,963	8,6
Container board	6,740	5,766	6,323	5,830	4,680	5,079	4,944	4,315	4,131	4,228	4,0
Folding boxboard	2,427	2,193	2,362	2,352	1,943	2,024	2,257	2,317	2,092	2,116[c]	2,0
Setup boxboard	755	687	733	712	617	596	595	521	721	750	8
Cardboard	88	69	85	87	83	87	92	89	71	70	
Building board	1,401	1,305	1,269	1,220	839	1,270	1,072	956	895	1,087[d]	1,0
Wet machine board	155	139	148	166	131	142	150	138	112	130	1
Other board	2,295	2,056	2,116	1,944	1,674	1,580	1,300	1,154	891	581	4

[a] Preliminary. [b] Includes small amounts of "other fine papers." [c] Includes all grades of bending board. [d] Includes liner for gypsum and stock for lamin wallboard.

Source: Prepared by the Forest Products Division—Business and Defense Services Administration, based upon data from Bureau of the Census, U. S partment of Commerce.

Table XVI. Newsprint—United States Production, Imports, Exports, Domestic Consumption, and Inventories

(1000 short tons)

Item	1953[a]	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1
Production	1065	1109	1108	1013	918	876	833	773	725	721	811	9
Imports	5004	5033	4963	4863	4639	4395	3958	3492	2669	2491	2637	29
Re-exports[b]	n.a.	n.a.	n.a.	n.a.	5	2	2	2	3	9	2	
Exports	47	105	71	44	39	28	28	28	44	31	35	
Total supply	6022	6034	6000	5832	5513	5241	4761	4235	3347	3172	3411	38
Inventories, total	560	624	530	433	457	467	386	308	273	350	378	
Publishers[c]	552	612	522	425	446	458	377	293	266	342	367	
Mill	8	12	8	8	11	9	9	15	6	7	11	
Change in stocks	−64	+94	+97	−24	−10	+81	+78	+35	−77	−28	−112	+
Apparent consumption	6086	5940	5903	5856	5523	5160	4683	4200	3424	3200	3523	37

[a] Preliminary. [b] Re-exports of newsprint included in the general import statistics. [c] Reported by 422 publishers of 525 newspapers consuming approxima 76% in 1952; 75.5% in 1951; 76.5% in 1950; 77% in 1949; 78% in 1948; and 75% in 1947; 73% in 1946; 70% in the first half and 71% in second ha 1945; 72.5% in 1944; and 75% in 1943.

n.a. Not available.

Source: Production, import, and export figures, Bureau of the Census, U. S. Department of Commerce; publishers' inventories, American Newspaper lishers' Association; mill inventories, News Print Service Bureau; consumption equals supply adjusted for change in stocks

Table XVII. Production of Newsprint in North America

(1000 short tons)

Year	Total[a]	United States	Canada	Newfoundland	Year	Total[a]	United States	Canada	Ne found
1953[b]	6786	1065	5721	[c]	1945	4317	725	3259	33
1952	6796	1109	5687	[c]	1944	3985	721	2992	27
1951	6624	1108	5516	[c]	1943	4030	811	2983	23
1950	6292	1013	5279	[c]	1942	4422	967	3177	27
1949	6092	918	4732	444	1941	4815	1044	3426	34
1948	5859	876	4601	382	1940	4826	1056	3419	35
1947	5653	833	4447	373	1939	4129	954	2869	30
1946	5279	773	4143	363					

[a] Details may not add to total because of rounding. [b] Preliminary. [c] Data for Canada include figures for Newfoundland.

Source: United States, Bureau of the Census, U. S. Department of Commerce; Canada and Newfoundland, Newsprint Association of Canada.

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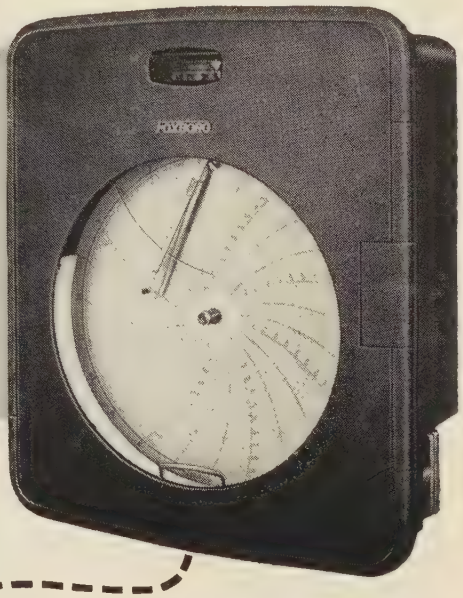

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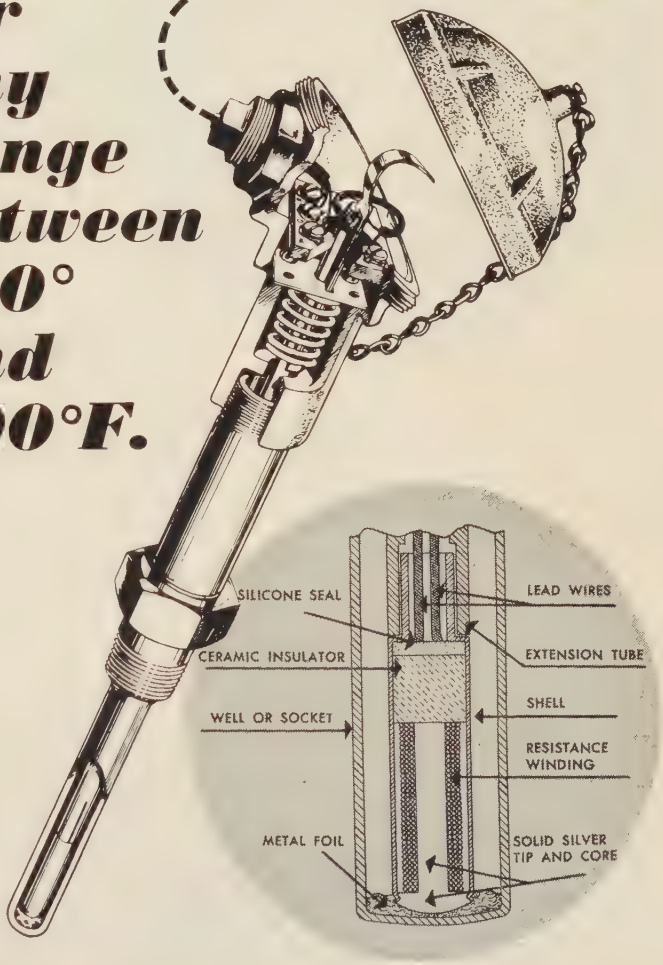

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FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Table XVIII. Newsprint—United States Imports by Country of Origin

(1000 short tons)

Source	1953[a]	1952	1951	1950	1949	1948	1947	1946
Total[b]	5004	5033	4963	4863	4639	4395	3958	3492
Canada[c]	4841	4850	4756	4690	4382	4127	3829	3478
Finland	145	162	160	144	151	132	84	12
Sweden	16	16	30	18	37	70	25	
United Kingdom	...	...	...	[d]	35	3	...	...
Norway	3	4	9	4	30	28	6	...
France	...	...	5	2	2	28	10	...
All other countries	...	1	3	2	1	7	4	...

[a] Preliminary. [b] Data do not necessarily add to total because of rounding. [c] Includes Newfoundland. [d] Less than 500 short tons.
Source: Bureau of the Census, U. S. Department of Commerce.

quantity of hardwood pulpwood is being utilized. Also evident has been the rapid rise in the production of dissolving pulp, as well as the steady increase in sulphate pulps. Sulphite and soda production has shown little change in recent years.

A substantial increase in wood pulp production capacity in the United States as well as in Canada in the last few years, together with a large new mill now under construction in Alaska, points to a lesser dependence upon overseas supplies of market wood pulp. In fact, as indicated earlier, some United States mills look toward a growing export market.

United States imports of wood pulp in 1953, amounting to 2,157,000 tons, reflected a small gain over 1952 in receipts from Canada (up about 35,000 tons) but a larger increase from overseas sources (up about 185,000 tons). This reflected the price reductions made by overseas shippers early in 1952, whereby overseas price quotations were more attractive to some buyers than were North American prices. It is believed that the supply of most grades of wood pulp on the international market in the year 1954 will be in approximate balance with demand, resulting in a more firm and steady market than has existed in the previous three or four years.

United States wood pulp inventories at the end of 1953 were considered satisfactory relative to consumption, b slightly below those at the end of 1952 but materially gr than those at the end of 1950 when a world shortage in developed.

WASTE PAPER

The year 1953 witnessed a much stronger demand for w paper than existed in 1952. Yet, for the year as a w consumption was below the all-time peak of 1951.

The near capacity production of most grades of paperb during practically all of 1953 accounted for the stronger mand for waste paper. Historically, whenever paperb demand recedes noticeably and waste paper consumption clines, the prices of waste paper recede even more seve Conversely, with an upturn in paperboard production a resulting demand for waste paper, prices rise quickly. tainer board and box boards first felt the impact of req ments to meet the initial stages of the Korean conflict. sharply rising demand for paperboard in late 1950 and first half of 1951 necessitated a much larger volume of material, especially waste paper. To bring into the ma these larger supplies of waste paper required sharply r prices in that area. As a consequence, paperboard price

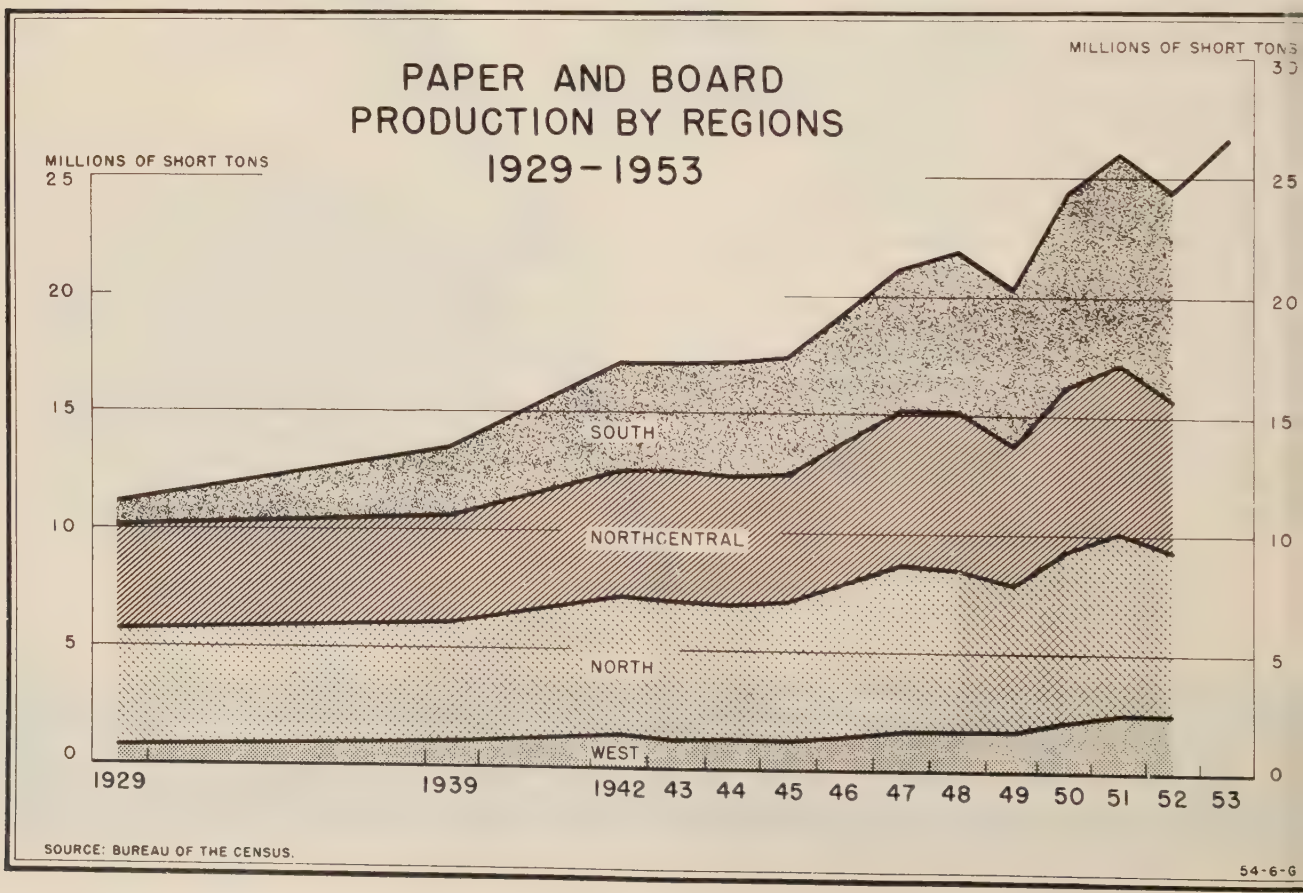

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Table XIX. Monthly Value of Sales by United States Pulp, Paper, Board, and Products Manufacturers, 1947–53 (Unadjusted)

(Millions of dollars)

Month	1953[a]	1952[b]	1951[b]	1950[b]	1949	1948	1947	Month	1953[a]	1952[b]	1951[b]	1950[b]	1949	1948
January	723	703	714	501	458	504	458	August	742	668	725	645	462	519
February	683	663	686	495	432	489	449	September	745	674	670	616	490	521
March	747	683	775	567	476	532	469	October	783	740	737	673	506	532
April	739	657	743	518	438	516	482	November	709	657	685	670	497	498
May	724	650	774	554	422	500	494	December	683	655	608	658	463	473
June	734	630	732	562	432	520	474	Total	8701	7979	8477	6976	5448	6060
July	689	599	627	517	372	456	431							

[a] Preliminary. [b] Revised.
Source: Office of Business Economics. The estimated dollar total of sales represents receipts of all operators of paper manufacturing companies. figures include data for both corporate and noncorporate businesses, but are comparable to the sales data for corporations in Statistics of income published Bureau of Internal Revenue.

themselves advanced substantially in 1951 to a high point from which prices have since receded. On the other hand, paper prices have shown a general upward trend during the past 4 or 5 years.

Waste paper is probably one of the very few commodities for which the 1953 price ranges below the mean level of 1947–49. Much remains to be done by individual waste paper firms as well as by consuming mills in terms of supply, distribution, and inventory practices so as to place the waste paper business on a more firm and more stable basis. This, however, is most difficult because of the large number of very small, independent dealers engaged in this business.

PAPER AND BOARD

An analysis of Table XV will disclose the 1953 trends in the production of the major grades of paper and board. For the most part, production in these groups showed increases over 1952, and in many cases established all-time records. However, newsprint, groundwood papers, and fine papers showed moderate declines from the previous year. It is possible that, particularly in the fine paper field, the industry may have encountered a later inventory cycle than that in most grades. It would appear that fine paper production in and 1952 might have been somewhat in excess of actual sumption with an accumulation of inventories which we large measure used up in 1953. As a consequence, pro tion in this grade group, as well as in probably most grade groups, in the year 1954 should be relative to ov industrial and economic activity in the country.

The decline in domestic newsprint production in notwithstanding a moderate increase in newsprint cons tion, is accounted for by two or three small mills switc to other grades or ceasing operation. Domestic news production in 1954 should show a material rise and prob establish a new high point for the past couple of dec Two important domestic mills expect to place new cap in operation during the year.

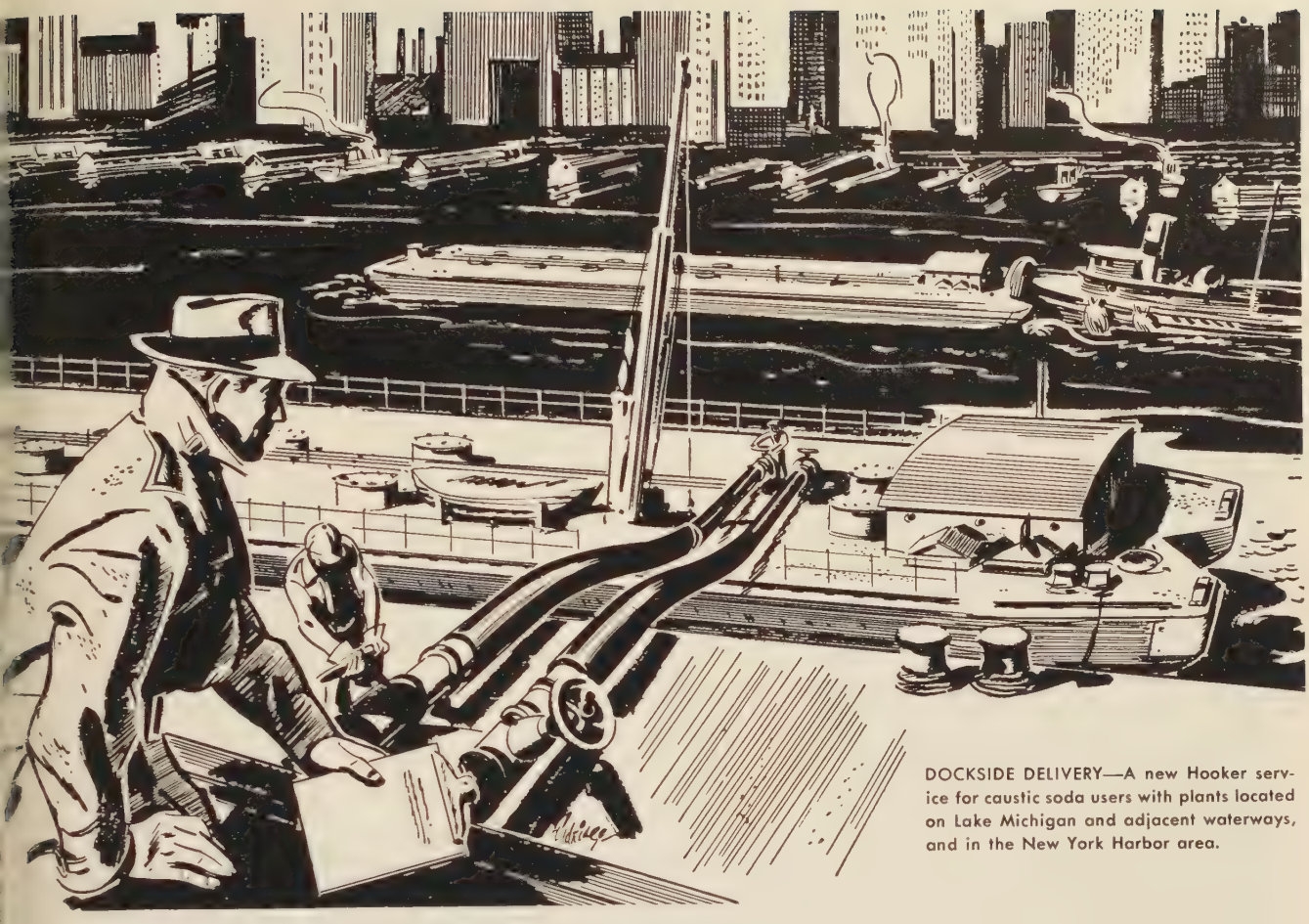
Newsprint supply and consumption in the United Stat always an important consideration. A new peak of 6,08 tons of apparent total newsprint consumption was rea in 1953—a gain of 146,000 tons over 1952. A part of consumption was drawn from stocks to the amount of 64

Table XX. Wholesale Price Index Numbers for Selected Subgroups and Classes of Wood Pulp, Paper, Paperboard, Converted Products, and Other Selected Commodity Groups

(Index 1947–49 = 100)

Item	1953[a]	1952	1951	1950	1949	1948	1
All commodities other than farm and foods	114.1	113.0	115.9	105.0	101.3	103.4	9
Pulp, paper, and products group	116.1	116.6	119.6	100.9	98.5	102.9	9
Wood pulp subgroup	109.0	111.5	114.4	95.6	97.0	107.3	9
Sulphate, Southern, unbleached	92.3	109.9	120.7	88.5	89.2	112.6	9
Sulphate, bleached	107.9	107.9	116.3	93.9	101.5	119.1	7
Sulphite, bleached	112.0	112.0	112.0	98.1	98.7	104.2	9
Mechanical	110.0	118.1	122.1	89.6	91.5	106.7	10
Soda, bleached	112.9	112.9	112.9	96.5	97.9	106.1	9
Waste paper subgroup	90.7	70.1	188.2	119.5	61.3	90.4	14
Books and magazines	65.7	110.2	195.9	114.4	71.7	90.7	13
Folded news	98.3	67.2	148.8	114.6	65.7	91.0	14
Mixed paper	96.9	56.6	193.9	128.3	48.8	84.1	16
Corrugated	93.9	61.4	207.3	119.5	61.2	93.8	14
Paper subgroup	125.6	124.0	119.1	106.5	103.8	102.8	9
Paper, except newsprint class	123.6	123.5	120.4	106.5	103.3	103.1	9
Hanging	125.1	125.1	119.6	104.5	105.4	105.1	8
Printing paper	117.0	117.0	110.7	102.7	102.2	101.3	9
Bookpaper	127.4	125.8	119.8	108.5	105.2	100.7	9
Wood bond	118.6	117.8	115.7	105.2	103.1	104.4	9
Writing paper	127.1	127.1	125.1	110.5	101.4	102.3	9
Wrapping paper	127.4	124.5	122.3	106.7	103.1	104.8	9
Butcher's paper	128.6	128.1	126.8	108.5	102.7	103.2	9
Waxing paper	118.0	124.4	122.7	103.9	102.4	105.1	9
Wrapping tissue	115.6	122.8	132.2	100.0	99.4	104.9	9
Newsprint class	131.1	125.7	115.4	106.2	105.5	101.9	9
Paperboard subgroup	124.3	127.4	131.8	105.0	98.8	102.0	9
Container board class	117.2	115.6	117.8	102.8	100.5	100.1	9
Folding boxboard class	140.1	144.8	150.0	109.7	99.4	103.0	9
Setup boxboard class	117.1	128.1	135.9	103.1	94.3	104.5	10
Converted products subgroup	112.2	113.8	116.9	97.7	97.1	102.4	10
Building paper and board subgroup	121.4	115.3	113.4	107.6	104.2	102.8	9
Fuel and power group	109.4	106.6	106.7	103.0	101.9	107.1	9
Chemicals and allied products group	105.7	104.5	110.1	96.3	94.8	103.8	10

[a] Preliminary.
Source: Prepared by the Forest Products Division, Business and Defense Services Administration, Department of Commerce, based upon data supplied b Bureau of Labor Statistics, U. S. Department of Labor.



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tons. Imports declined slightly to 5,004,000 tons, whereas United States exports of newsprint declined from 105,000 tons in 1952 to 47,000 tons in 1953.

EXPORT TRADE

United States exports of pulp and paper products in 1953 were at a fairly high level, but for the most part were somewhat below 1952. Wood pulp exports totaled 162,000 tons, compared with 212,000 tons the year previous. Total paper and paperboard exports amounted to 384,000 tons in 1953, recording a decline of 115,000 tons below 1952. In similar comparison 1953 exports of paper and board products were 91,000 tons against 93,000 tons in 1952.

In many foreign markets 1953 witnessed a liquidation of excess stocks of pulp and paper acquired in the last 2 years. As a consequence, demand in these countries slackened in 1953, while at the same time, sales competition among the producing exporting countries increased.

IMPORT TRADE

United States imports of pulpwood in 1953 totaled 1,548,000 cords, disclosing a substantial drop in the volume of pulp imports as compared with the previous several years. is explained by the fact that many northern mills in the U States had accumulated excess inventories of pulpwood d 1951 and 1952, when the threat of labor difficulties and shortages existed. As a consequence, these mills saw restrict acquisition of pulpwood in 1953, particularly so the more costly pulpwood from the more remote pa Canada.

Wood pulp imports in 1952 have been referred to earlier section of this report.

In the field of paper and paperboard imports, the one la single item is newsprint, which amounted to 5,004,000 ton 1953, a slight decline under 1952 but nevertheless the sec highest volume of imports of newsprint on record. bulk of the imports of newsprint were from Canada, amou ing to 4,841,000 tons. However, imports from overs sources in 1953 were 164,000 tons compared with 183, tons for 1952. Table XXII shows the trends of imports individual grade groups of paper and paperboard for the p several years.

Table XXI. United States Exports of Pulpwood, Wood Pulp, Paper, Paperboard, and Paper Products
(In short tons except where otherwise indicated)

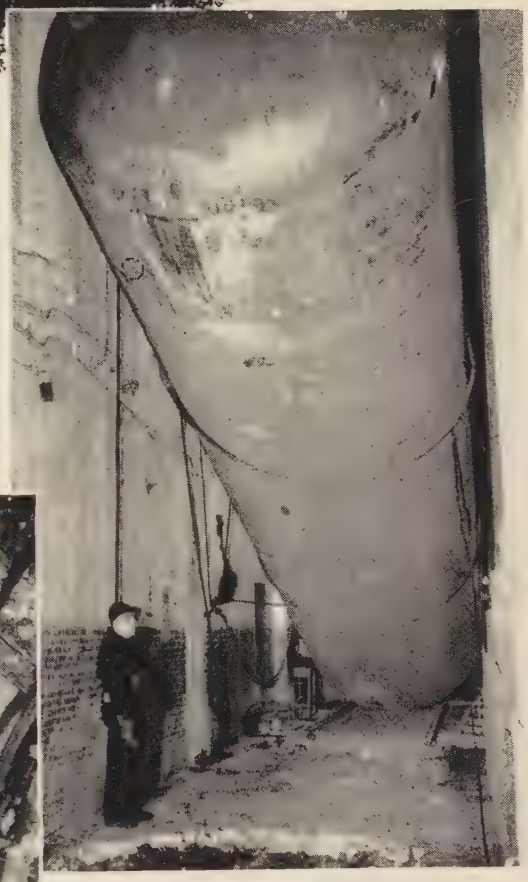
Item	1953[a]	1952	1951	1950	1949	1
Pulpwood (in cords of 128 cu. ft.)	10,943	16,819	13,074	27,053	7,689	38
Wood pulp, total	161,687	211,924	199,708	95,673	122,133	93
Bleached sulphite: Rayon and special chemical grades	68,503	65,233	31,157	27,634	25,493	17
Bleached sulphite: other	18,473	23,683	44,165	18,364	19,770	13
Unbleached sulphite	30,748	34,548	43,672	32,836	39,383	53
Bleached sulphate	13,419	11,604	9,488	4,709	9,542	
Unbleached sulphate	28,830	75,864	68,464	9,555	27,234	6
Soda, screenings, and other wood pulp	1,714	992	2,762	2,575	711	1
Waste fibrous materials, total	113,746[h]	150,755	216,715	126,874	125,308	169
Overissue news	67,181	77,824	102,383	68,495	74,265	23
Rags for paper stock	[i]	8,384	10,277	7,173	8,111	12
Other waste paper and paper stock	46,565	64,547	104,055	51,206	42,932	134
Paper, paperboard, and paper products, total	475,990	592,388	635,303	371,546	372,277	397
Paper and paperboard, total	383,505	499,197	527,897	297,182	294,860	295
Paper, total	189,346[b]	325,553[b]	277,164[b]	175,157[b]	181,035[c]	161
Newsprint	46,676	104,998	71,295	43,966	38,660	27
Book paper, uncoated	16,249	48,132	33,851	20,123	28,230	44
Fine paper, total[d]	33,894	40,450	47,776	38,535	43,656	45
Writing paper	24,015	32,128	35,246	29,801	32,901	29
Cover paper	881	920	810	547	[e]	1
Bristols	924	911	1,409	1,071	1,034	5
Cigarette paper	7,132	5,501	8,790	6,580	8,327	8
Wrapping, bag, and converting paper, total	53,797	88,383	76,506	39,892	28,062	28
Kraft, including shipping sack paper	46,574	77,677	60,792	28,563	17,652	10
Greaseproof and waterproof paper[f]	2,127	2,853	5,489	3,843	3,297	8
Other paper	5,095	7,852	10,225	7,486	7,113	9
Sanitary and tissue paper	6,024	5,288	7,294	7,433	10,029	4
Blotting paper	2,944	2,610	2,854	2,735	2,761	2
Sheathing and building paper	8,704	7,827	10,015	8,321	9,218	7
Paperboard, total	194,159	173,644	250,733[g]	122,025[g]	113,825[g]	133
Container board (liners and corrugating)	110,733	92,851	134,613	59,940	49,900	49
Boxboard (bending and nonbending)	30,749	23,129	50,040	14,944	20,105	12
Other paperboard	31,243	32,927	41,121	23,678	19,269	35
Fiber insulation board	17,167	16,515	20,210	15,700	18,872	18
Wallboard	4,267	8,222	4,749	7,763	5,679	17
Paper products, total	91,259	93,191	107,406	74,364	77,417	101,
Surface-coated paper	[e]	[e]	[e]	[e]	[e]	12
Toilet paper	10,330	7,918	9,406	7,383	8,046	7
Paper towels and napkins	3,203	2,757	2,736	1,972	1,867	1
Filing folders, index cards, and other office forms	3,942	3,483	3,699	3,772	2,636	1
Papeteries	[e]	[e]	407	359	366	
Wallpaper	182	280	258	206	205	
Shipping sacks	8,947	12,985	19,803	10,128	5,716	22,
Paper bags	4,834	5,296	6,462	7,101	10,293	6,
Shipping containers	13,407	15,230	14,867	7,795	9,822	9,
Boxes and cartons	8,567	10,021	9,688	5,247	5,365	5,
Envelopes	483	552	525	502	700	
Cash register and adding machine paper	[e]	[e]	[e]	[e]	[e]	4,
Other paper and paper products	37,364	34,670	39,555	29,899	32,401	29,

[a] Preliminary. [b] Includes special industrial and coated printing and converting paper. [c] Includes 7297 tons of uncoated and paper machine coated pa
[d] Includes small quantity of miscellaneous thin paper and other paper not shown separately. [e] Not shown separately. [f] Includes glassine and vegetable pa
ment. [g] Total board including paperboard, building board and wet machine board. [h] Excludes rags for paper stock for 1953. [i] Data on rags for paper s
not available after June, 1953.
Source: Prepared by the Forest Products Division—Business and Defense Services Administration, based upon data from the Bureau of the Census, U
Department of Commerce.

New Digesters replace worn-out units at Champion Mill

The accompanying views show one of three 9-ft. 9-in. diam. by 48-ft. 9-1/2-in. digesters being installed as replacements at the Champion Paper & Fibre Company mill at Canton, North Carolina. They were built by the Chicago Bridge & Iron Company and installed by Champion riggers.

We build digesters for the production of pulp in every pulp mill area of the United States. Write our nearest office for quotations on digesters or other steel plate structures to meet your paper mill needs.



With one end hoisted off the ground and the other on rollers, one of the three 50-ton digesters is moved into the spot where it will be installed. All three of the new digesters were constructed of type A-285 Grade C firebox quality steel.

A hole was dug to give the digester clearance under beams. Within nine days after the old digester started moving out, the new digester shown in the view at left was on the line and in full production.

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Atlanta, 3.....2133 Healey Building
Birmingham, 1.....1543 North 50th Street
Boston, 10.....1057—201 Devonshire Street
Chicago, 4.....2140 McCormick Building
Cleveland, 15.....2238 Midland Building
Detroit, 26.....1548 Lafayette Building
Houston, 2.....2156 C & I Life Building
Los Angeles, 17....1550 General Petroleum Building
New York, 6.....3324—165 Broadway Building
Philadelphia, 3...1642—1700 Walnut Street Building
Pittsburgh, 19.....3257 Alcoa Building
Salt Lake City, 4..... 562 West 17th South Street
San Francisco, 4.....1538—200 Bush Street
Seattle, 1.....1362 Henry Building
Tulsa, 3.....1645 Hunt Building

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Table XXII. United States Imports of Pulpwood, Wood Pulp, Paper, Paperboard, and Paper Products

(In short tons, except where otherwise indicated)

Item	1953[a]	1952	1951	1950	1949	1948	1
Pulpwood, total (in cords of 128 cu. ft.)	1,553,550	2,124,880	2,511,401	1,412,365	1,418,468	2,020,979	1,82
Rough	454,955	820,275	883,390	373,460	510,134	913,838	93
Peeled	776,616	1,036,959	1,406,937	844,781	791,325	1,010,993	82
Rossed	5,603	3,142	3,931	151	447	806	
Chipped	316,376	264,504	217,143	153,973	116,562	95,342	7
Wood pulp, total	2,156,285	1,936,687	2,360,734	2,384,975	1,763,102	2,176,111	2,32
Bleached sulphite: Rayon and special chemical grades	255,781	222,608	230,800	238,846	153,946	235,481	24
Bleached sulphite: other	331,972	276,698	348,541	401,776	331,288	322,830	28
Unbleached sulphite	380,439	431,678	557,357	528,673	392,222	674,707	73
Bleached sulphate	590,745	519,035	521,560	450,352	391,609	277,989	23
Unbleached sulphate	292,072	207,871	335,573	440,378	248,814	336,449	47
Soda pulp	34,598	28,073	33,373	33,947	27,315	24,843	2
Chemical screenings	6,688	4,260	10,344	4,695	3,163	8,275	
Bleached mechanical groundwood	65,255	34,341	17,675	20,202	593	....	
Unbleached mechanical groundwood	194,080	207,899	300,418	260,347	208,224	290,984	30
Mechanical groundwood screenings	4,295	4,224	5,093	5,759	5,928	4,553	
Waste fibrous materials, total	65,654	78,825	116,500	131,147	72,055	102,845	8
Rags for paper stock	5,618	7,528	20,219	25,300	7,917	20,040	1
Other pulp-rag, straw, esparto, etc.	443	217	254	88	[b]	4	
Other waste fibrous materials	60,036	71,080	96,037	105,767	64,138	82,801	6
Paper, paperboard, and paper products, total	5,231,358	5,191,126	5,152,322	5,007,384	4,751,323	4,581,811	4,12
Paper and paperboard, total	5,212,851	5,173,352	5,139,254	4,998,347	4,746,248	4,575,095	4,11
Paper, total	5,088,798	5,089,593	5,024,870	4,912,974	4,676,126	4,499,682	4,05
Newsprint	5,004,050	5,033,014	4,962,562	4,862,995	4,639,562	4,395,572	3,95
Printing paper, uncoated	41,450	42,984	47,326	35,278	28,281	83,379	7
Fine paper, total	2,162	1,314	1,333	1,229	640	1,537	
Writing paper	94	79	74	115	37	120	
Cover paper	5	....	[b]	[b]	[b]	3	
Bristols	446	156	258	259	93	12	
Thin paper	1,458	952	799	710	419	1,344	1
Other fine paper	159	127	202	145	91	58	
Wrapping, bag, and converting paper, total	35,340	10,331	11,079	10,864	5,712	18,420	22
Kraft wrapping[c]	29,254	8,656	6,876	7,330	3,823	10,628	10
Greaseproof and waterproof paper	1,778	564	2,130	1,148	22	48	
Wrapping, except kraft[c]	4,308	1,111	2,073	2,386	1,867	7,744	11
Tissue and crepe paper	1,908	266	223	452	1,352	376	
Absorbent paper	126	129	94	101	122	92	
Building paper	3,762	1,555	2,253	2,055	457	306	
Paperboard, total	124,053	83,759	114,384	85,373	70,122	75,413	58
Kraft container board	33,325	4,385	967	....	....	....	
Other container and boxboard	372	175	1,739	465	3	629	2
Other paperboard	65,870	52,419	78,416	54,179	47,769	44,015	3
Fiber insulation board	4,029	3,824	3,015	3,319	275	400	
Wallboard	20,457	22,956	30,247	27,410	22,075	30,369	1
Paper products, total	18,507	17,774	13,068	9,037	5,075	6,716	5
Papeteries	140	219	133	155	73	38	
Surface-coated papers	1,057	2,404	1,002	265	40	32	
Uncoated papers, decorated or covered with a design, etc.	66	78	103	25	1	7	
Wallpaper	3,223	2,879	2,303	2,638	1,365	1,259	1
Decalcomania paper	774	608	1,277	1,110	619	957	
Boxes of paper, papier-mache, or paperboard (not covered or lined)	807	1,119	543	479	357	300	
Boxes of paper, papier-mache, or wood (covered or lined)	93	204	96	67	41	27	
Manufacturers of papier-mache, n.s.p.f.	198	163	154	106	58	51	
Manufacturers of pulp, n.s.p.f.	87	78	268	96	51	52	
Bags and articles of surface-coated, parchment, or similar papers	283	229	181	168	56	63	
Albums, photograph, autograph, scrap, etc.	6	4	2	6	2	3	
Envelopes	141	182	126	47	47	40	
Jacquard designs	[b]	[b]	....	[b]	[b]	....	[b]
Gummed paper, n.s.p.f.	28	9	211	19	[b]	1	
Tubes for holding yarn and thread	91	54	69	22	[b]	....	[b]
Wall pockets of paper, papier-mache, etc.	21	28	38	37	3	1	
Ribbon flycatchers	204	83	44	115	....	9	
Masks of paper, pulp, or papier-mache	29	30	31	8	6	....	
Reinforced or cloth-lined paper	3	[b]	[b]	[b]	[b]	....	
Stencil paper, not mounted	[b]	[b]	4	2	1	1	[b]
Papers, n.s.p.f.	2,865	2,185	1,729	1,133	400	652	
Manufacturers of paper, n.e.s.	8,391	7,218	4,754	2,539	1,955	3,223	1,

[a] Preliminary. [b] Less than one-half short ton. [c] Includes bag paper. Conversion factors derived from reported gross shipping weights. Stereotype m mat or board (included under absorbent paper)—1000 sq. in. = 1.43 lb.; papeteries—$500 = 1 ton. Boxes of paper, papier-mache, or paperboard (not cov or lined)—$140 = 1 ton. Manufacturers of papier-mache, n.s.p.f.—$2240 = 1 ton. Manufacturers of pulp, n.s.p.f.—$860 = 1 ton. Albums, photogr autograph, scrap, etc.—$3060 = 1 ton. Jacquard designs on ruled paper, etc.—$94,000 = 1 ton (price includes cost of die). Ribbon flycatchers—$840 = 1 Masks of paper, pulp, etc.—$760 = 1 ton. Papers, n.s.p.f.—$80 = 1 ton. Manufacturers of paper, n.e.s.—$360 = 1 ton. Wall pockets of paper, pa mache, etc.—10,000 wall pockets = 1 ton.

Source: Bureau of the Census, U. S. Department of Commerce.

"your valves* give about twice the service . . ."

Recent installation showing variable control of stock flow to Jordans or Refiners.

*Sandy Hill Gate Valves...of course

IT ISN'T JUST BY CHANCE that Sandy Hill Quick Opening Gate Valves give so much better service than other valves, as the above quotation from an enthusiastic user states. The reason is that these are *NOT ordinary valves.* Like most Sandy Hill products, they are especially designed and built for a specific purpose . . . in this case, the effective handling of pulp and paper stock and water under low pressure. Recommended and sold solely for controlling the flow of solids in suspension, such as pulps or slurries. They perform this function adequately, capably and long *BECAUSE:*

They are sturdily constructed and easily installed.

They can be opened in a fraction of the time required with screw valves.

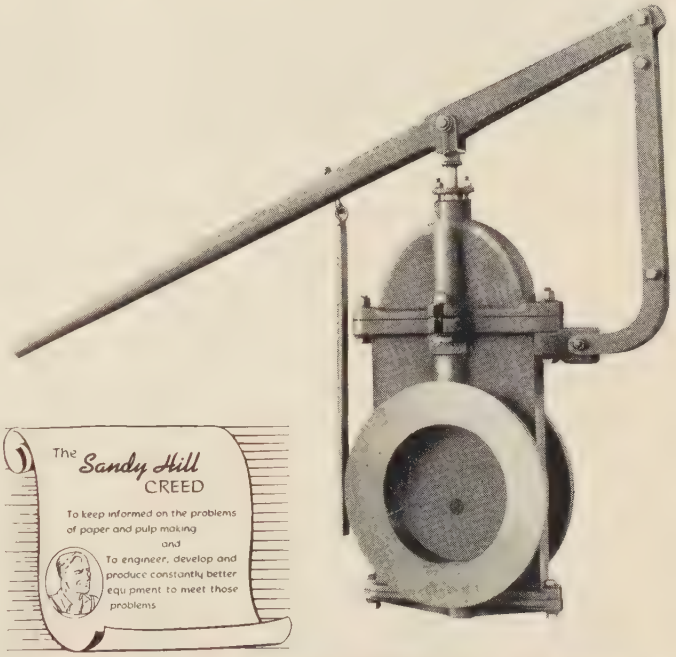
Slides can be held at any desired opening, and can be easily removed without taking valve from line.

Clogged valves can be cleaned by simply loosening and turning bottom plate.

Construction materials may be specified to resist any type of chemical exposure.

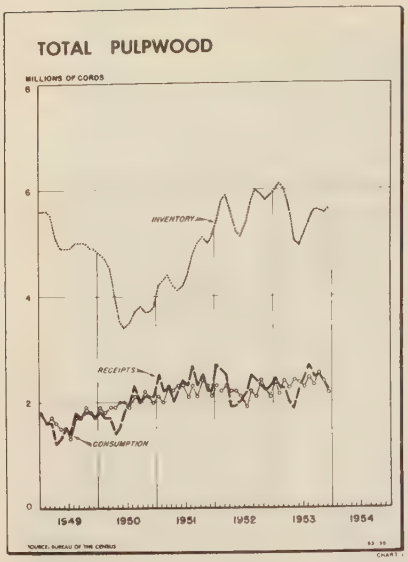
Stem end is cut standard pipe thread, permitting extension by connecting a piece of pipe. No threads on working part of stem to wear out.

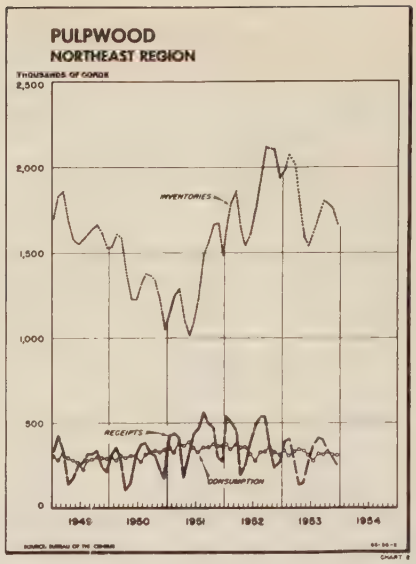
If you are interested in the expeditious handling of fluid pulps and slurries, with economical, trouble-free, low-maintenance, long term service, consult us.

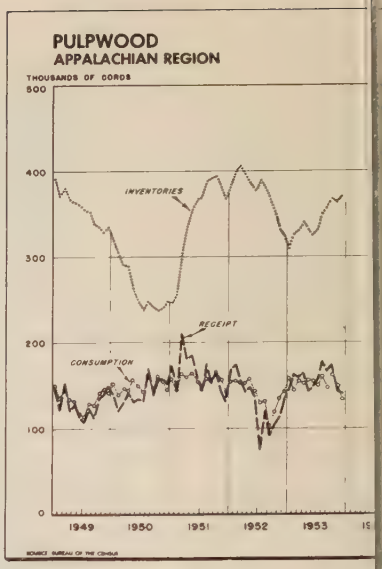


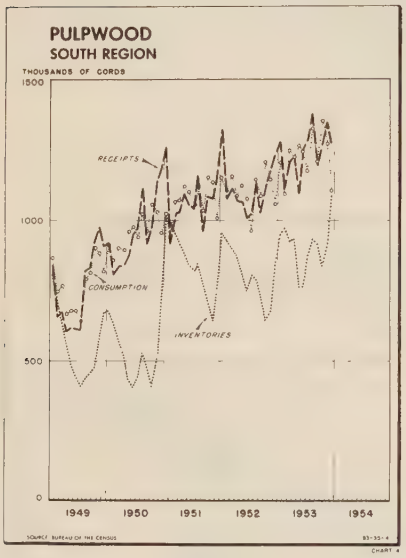
The Sandy Hill CREED
To keep informed on the problems of paper and pulp making
and
To engineer, develop and produce constantly better equipment to meet those problems

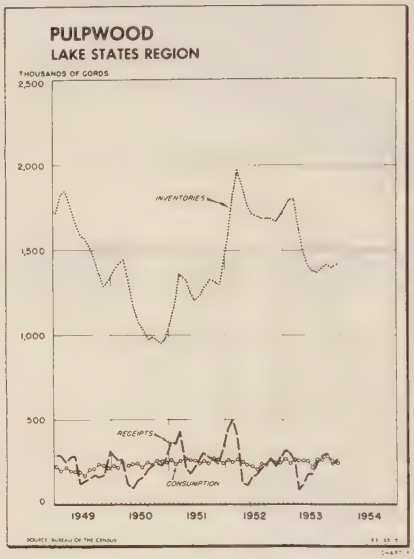
THE Sandy Hill IRON & BRASS WORKS
HUDSON FALLS, N.Y.

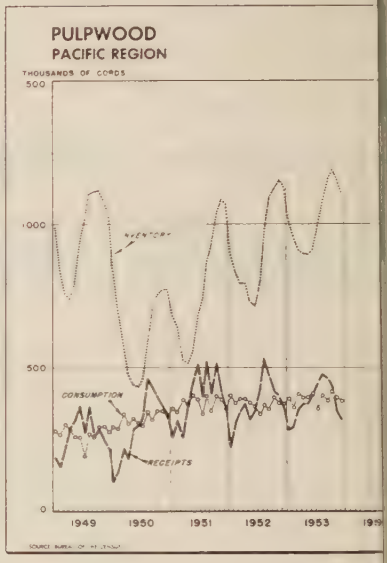

TOTAL PULPWOOD
MILLIONS OF CORDS
INVENTORY
RECEIPTS
CONSUMPTION
1949
1950
1951
1952
1953
1954

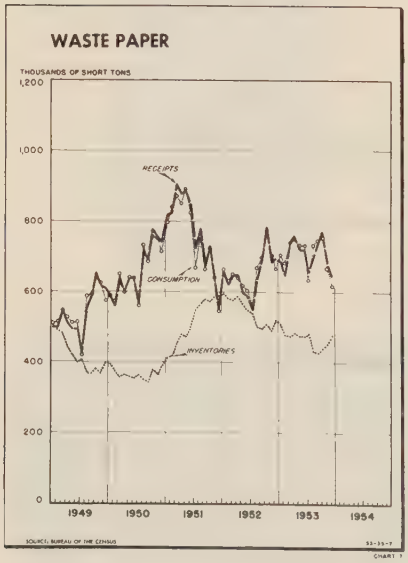

PULPWOOD
NORTHEAST REGION
THOUSANDS OF CORDS
INVENTORIES
RECEIPTS
CONSUMPTION
1949
1950
1951
1952
1953
1954

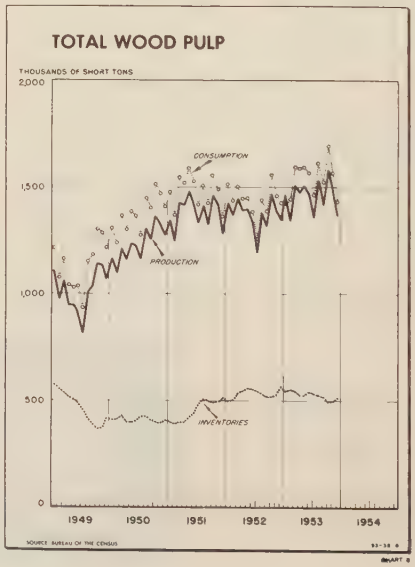

PULPWOOD
APPALACHIAN REGION
THOUSANDS OF CORDS
INVENTORIES
RECEIPT
CONSUMPTION
1949
1950
1951
1952
1953

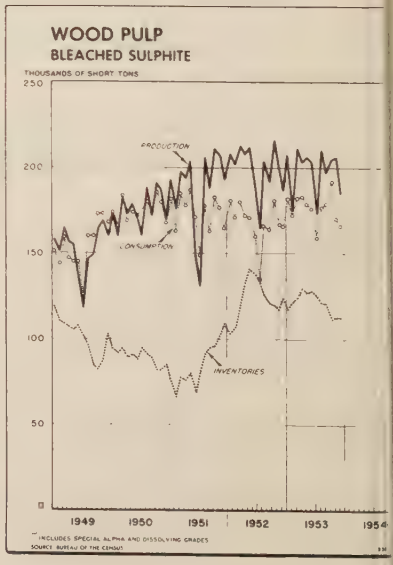

PULPWOOD
SOUTH REGION
THOUSANDS OF CORDS
RECEIPTS
CONSUMPTION
INVENTORIES
1949
1950
1951
1952
1953
1954


PULPWOOD
LAKE STATES REGION
THOUSANDS OF CORDS
INVENTORIES
RECEIPTS
CONSUMPTION
1949
1950
1951
1952
1953
1954

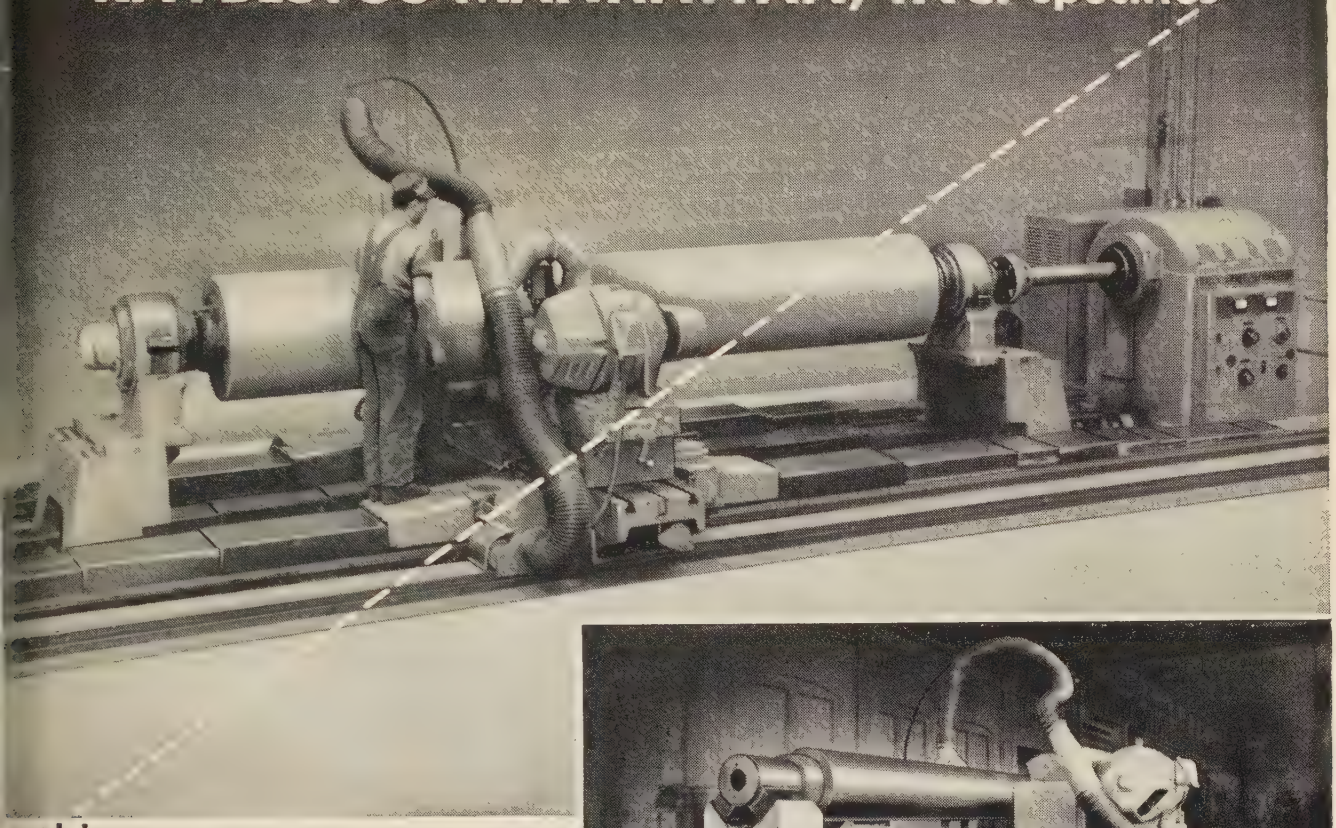

PULPWOOD
PACIFIC REGION
THOUSANDS OF CORDS
INVENTORY
CONSUMPTION
RECEIPTS
1949
1950
1951
1952
1953

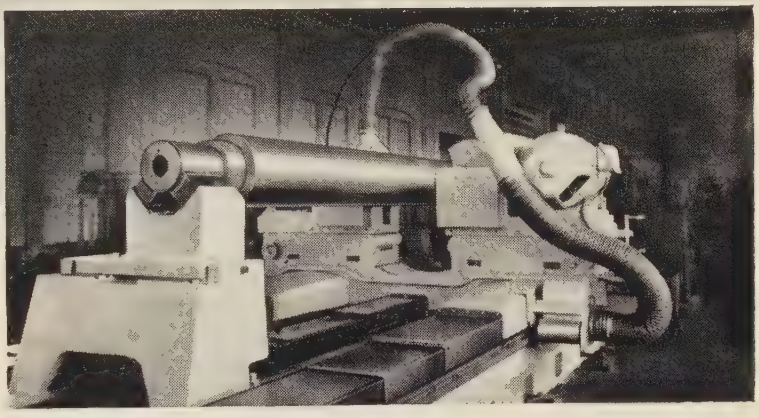

WASTE PAPER
THOUSANDS OF SHORT TONS
RECEIPTS
CONSUMPTION
INVENTORIES
1949
1950
1951
1952
1953
1954


TOTAL WOOD PULP
THOUSANDS OF SHORT TONS
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
1954


WOOD PULP
BLEACHED SULPHITE
THOUSANDS OF SHORT TONS
PRODUCTION
CONSUMPTION
INVENTORIES
1949
1950
1951
1952
1953

RAYBESTOS-MANHATTAN, INC. specifies





this

LOBDELL

GIANT "CW" ROLL GRINDER

60" capacity, 338" face roll for their new rubber covering plant at Neenah, Wisc.

here's why:

- Extremely accurate, rugged, with ease and flexibility of operation.
- The huge rolls of today's machines are within the medium range, rather than close to the top limit of this big Grinder's capacity.
- Accuracies of .00025" and closer are obtained on straight or crowned rolls of chilled iron.
- Two sizes . . . with capacities of 48" and 60" diameter and with bed length to suit the length of roll face.
- Designed for Direct Current operation, but for connection to an A.C. power supply.

Other LOBDELL Grinders, Type GHV for A.C. operation, are made in three smaller sizes to suit the requirements of any mill.

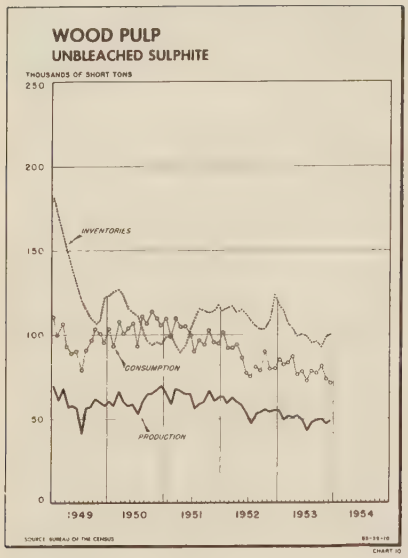
Our helpful Paper Mill Roll Grinders Catalog is yours for the asking.

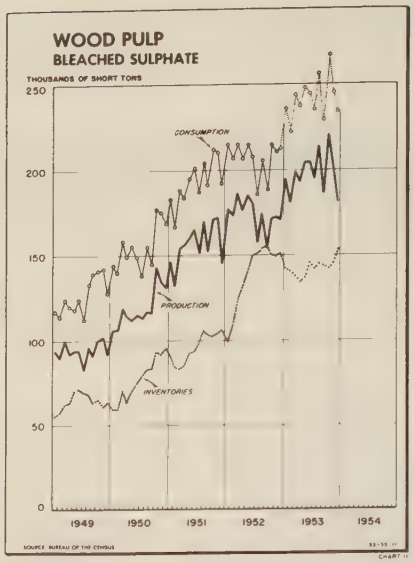
- CHILLED IRON ROLLS
- MACHINE CALENDER STACKS
- ROLL GRINDING MACHINES
- ROLL CALIPERS
- KNIFE GRINDERS
- ABRASIVE CUT-OFF SAWS

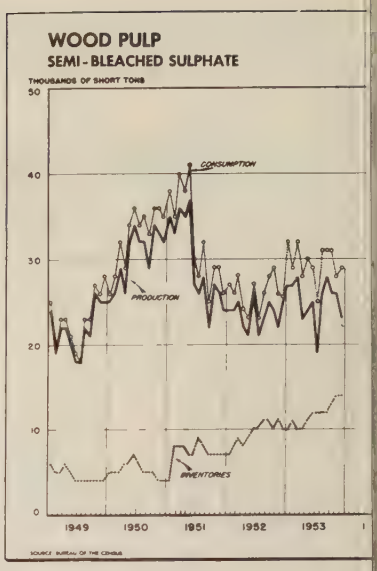
LOBDELL UNITED COMPANY

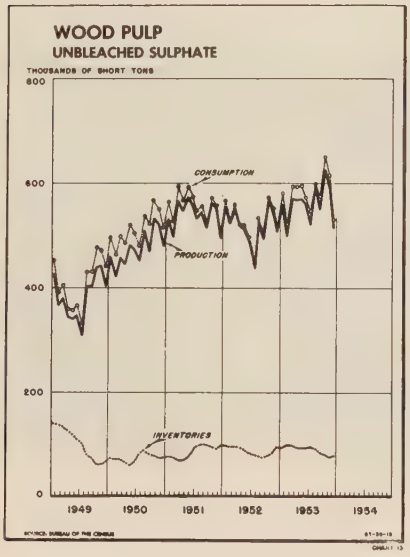
1836 WILMINGTON 99, DELAWARE 1954

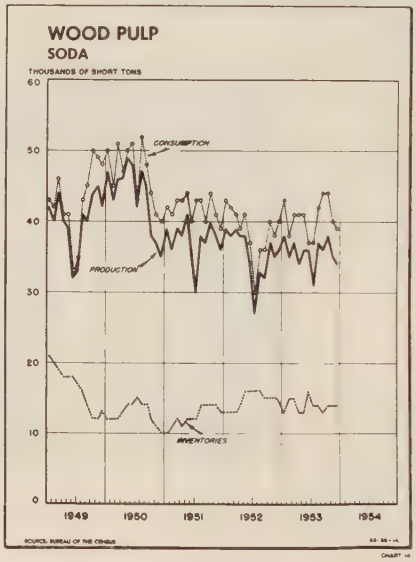
A SUBSIDIARY OF UNITED ENGINEERING AND FOUNDRY COMPANY

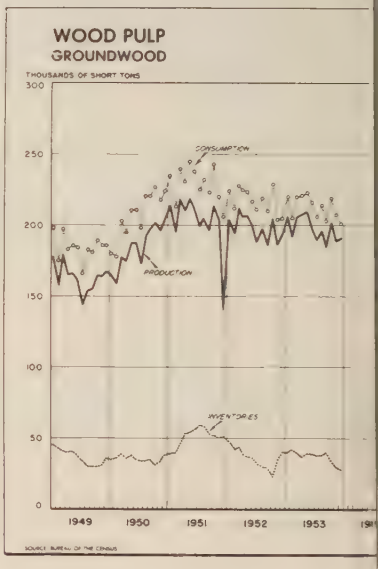

WOOD PULP
UNBLEACHED SULPHITE
THOUSANDS OF SHORT TONS
250
200
150
100
50
0
INVENTORIES
CONSUMPTION
PRODUCTION
1949
1950
1951
1952
1953
1954
SOURCE: BUREAU OF THE CENSUS
CHART 10

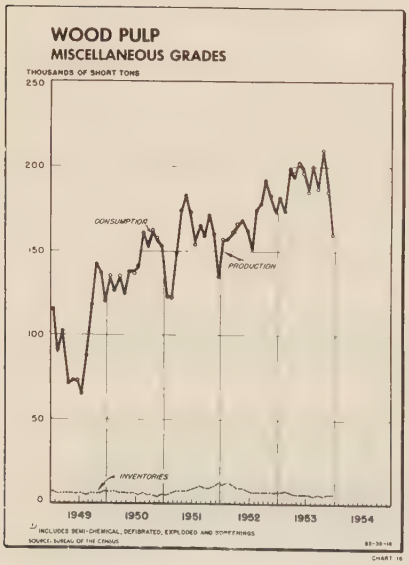

WOOD PULP
BLEACHED SULPHATE
THOUSANDS OF SHORT TONS
250
200
150
100
50
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
1954
SOURCE: BUREAU OF THE CENSUS
CHART 11

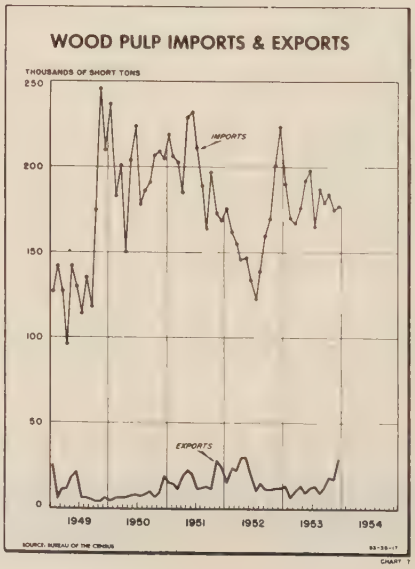

WOOD PULP
SEMI-BLEACHED SULPHATE
THOUSANDS OF SHORT TONS
50
40
30
20
10
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
SOURCE: BUREAU OF THE CENSUS

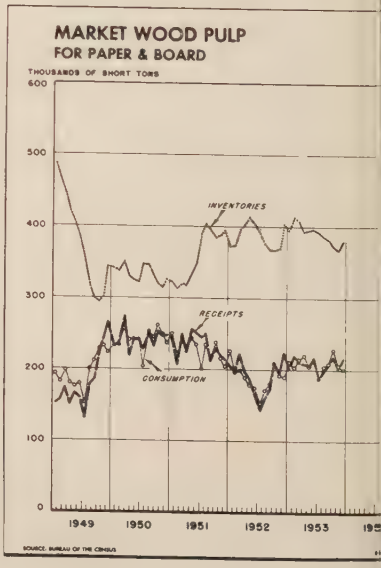

WOOD PULP
UNBLEACHED SULPHATE
THOUSANDS OF SHORT TONS
800
600
400
200
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
1954
SOURCE: BUREAU OF THE CENSUS
CHART 13


WOOD PULP
SODA
THOUSANDS OF SHORT TONS
60
50
40
30
20
10
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
1954
SOURCE: BUREAU OF THE CENSUS
CHART 14


WOOD PULP
GROUNDWOOD
THOUSANDS OF SHORT TONS
300
250
200
150
100
50
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
SOURCE: BUREAU OF THE CENSUS


WOOD PULP
MISCELLANEOUS GRADES
THOUSANDS OF SHORT TONS
250
200
150
100
50
0
CONSUMPTION
PRODUCTION
INVENTORIES
1949
1950
1951
1952
1953
1954
1/ INCLUDES SEMI-CHEMICAL, DEFIBRATED, EXPLODED AND SOFTENINGS
SOURCE: BUREAU OF THE CENSUS
CHART 15

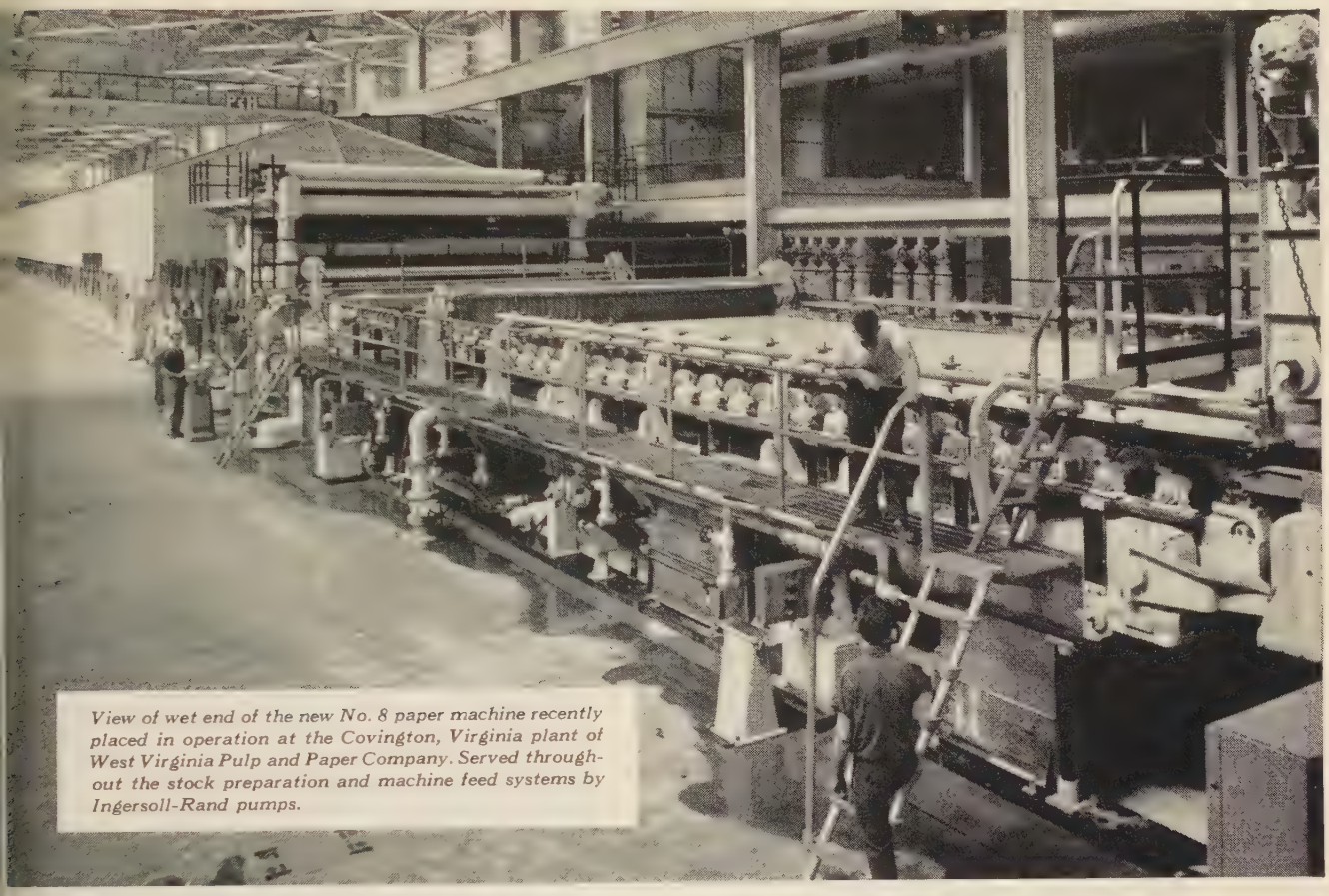

WOOD PULP IMPORTS & EXPORTS
THOUSANDS OF SHORT TONS
250
200
150
100
50
0
IMPORTS
EXPORTS
1949
1950
1951
1952
1953
1954
SOURCE: BUREAU OF THE CENSUS
CHART 7


MARKET WOOD PULP
FOR PAPER & BOARD
THOUSANDS OF SHORT TONS
600
500
400
300
200
100
0
INVENTORIES
RECEIPTS
CONSUMPTION
1949
1950
1951
1952
1953
SOURCE: BUREAU OF THE CENSUS

Proven dependability of Ingersoll-Rand pumps

IEETS WEST VIRGINIA PULP and PAPER CO. NEEDS

on New Machine Project at Covington Mill



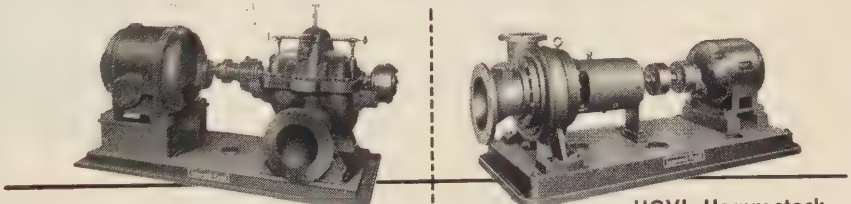
View of wet end of the new No. 8 paper machine recently placed in operation at the Covington, Virginia plant of West Virginia Pulp and Paper Company. Served throughout the stock preparation and machine feed systems by Ingersoll-Rand pumps.

RECENTLY placed in operation at the Covington, Virginia plant of ie West Virginia Pulp and Paper ompany, the new No. 8 machine rep- sents the latest in paper making uipment. Capable of producing 200 ns per day, it is designed to make aper of top quality and uniformity om local hardwood pulp—including avy grades of bleached board as well almost any other basis weight de- red.

Ingersoll-Rand pumps serve in prac- cally every phase of the stock prepara- on and machine feeding process for is new machine. Noted for high effi- ency and trouble-free performance, ey range from the 24″ single-stage lass ALV centrifugal fan pump to lasses HGVL and EGV single-stage rtically-split paper-stock pumps and lass BEV two-stage water pumps. Altogether, 18 of the 200 I-R pumps installed at Covington serve No. 8 machine.

More and more mills seeking answers to varied pumping problems are finding a dependable solution in the complete Ingersoll-Rand pulp and paper mill pump line. Ask to have an experienced field engineer study your situation, and submit recommendations to meet your particular requirements.

TWO OF THE I-R PUMPS ON NO. 8 MACHINE



ALV: White water

HGVL: Heavy stock

986-10

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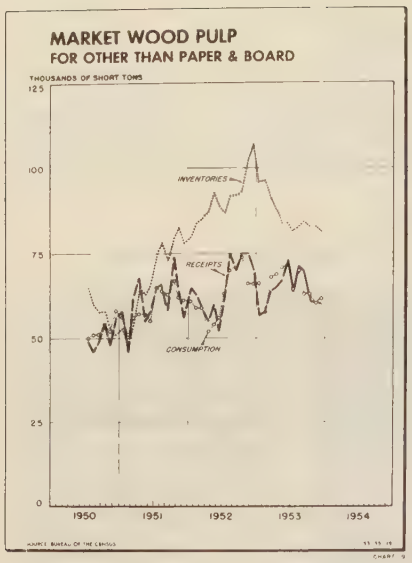
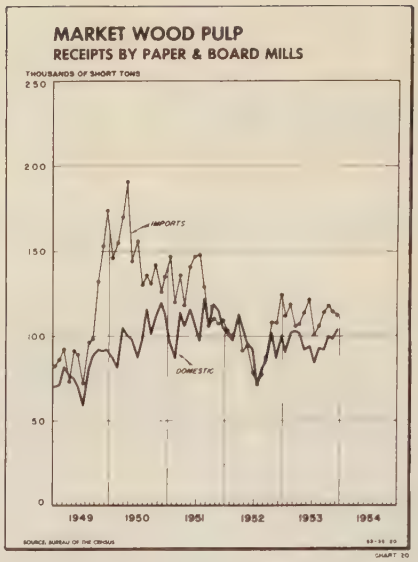
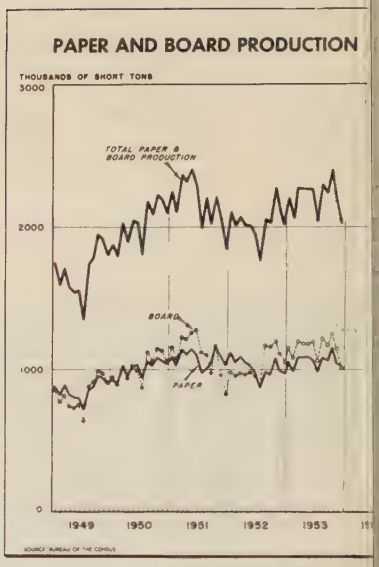
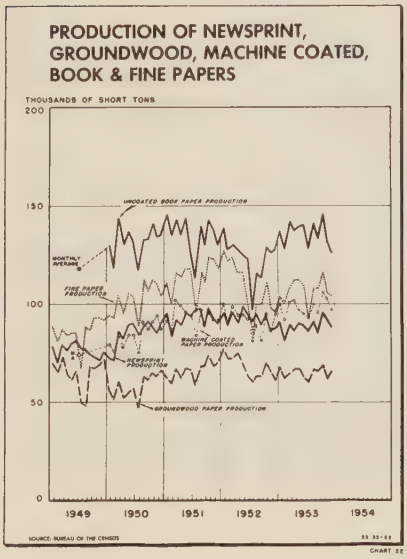
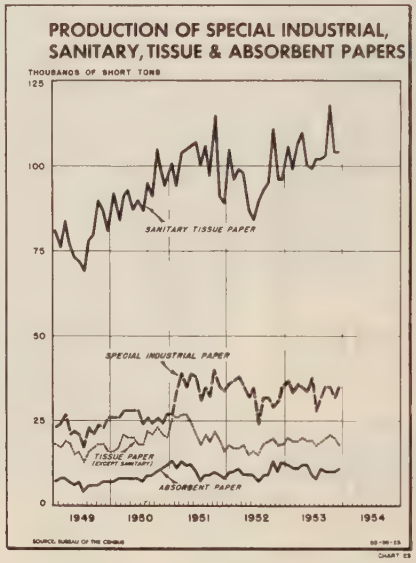

MARKET WOOD PULP
FOR OTHER THAN PAPER & BOARD
THOUSANDS OF SHORT TONS
INVENTORIES
RECEIPTS
CONSUMPTION
1950
1951
1952
1953
1954

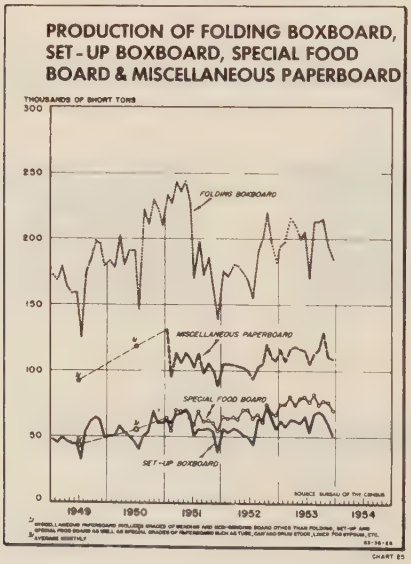

MARKET WOOD PULP
RECEIPTS BY PAPER & BOARD MILLS
THOUSANDS OF SHORT TONS
IMPORTS
DOMESTIC
1949
1950
1951
1952
1953
1954

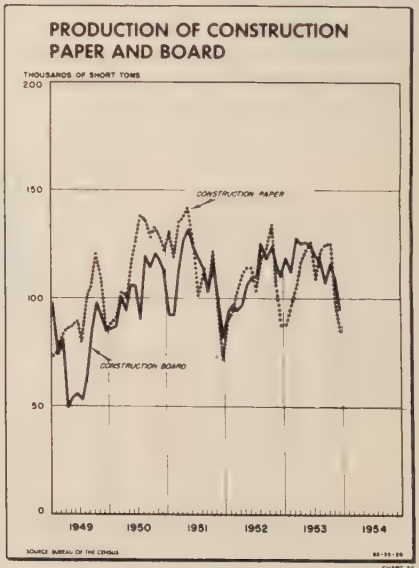

PAPER AND BOARD PRODUCTION
THOUSANDS OF SHORT TONS
TOTAL PAPER & BOARD PRODUCTION
BOARD
PAPER
1949
1950
1951
1952
1953


PRODUCTION OF NEWSPRINT, GROUNDWOOD, MACHINE COATED, BOOK & FINE PAPERS
THOUSANDS OF SHORT TONS
UNCOATED BOOK PAPER PRODUCTION
MONTHLY AVERAGE
FINE PAPER PRODUCTION
MACHINE COATED PAPER PRODUCTION
NEWSPRINT PRODUCTION
GROUNDWOOD PAPER PRODUCTION
1949
1950
1951
1952
1953
1954

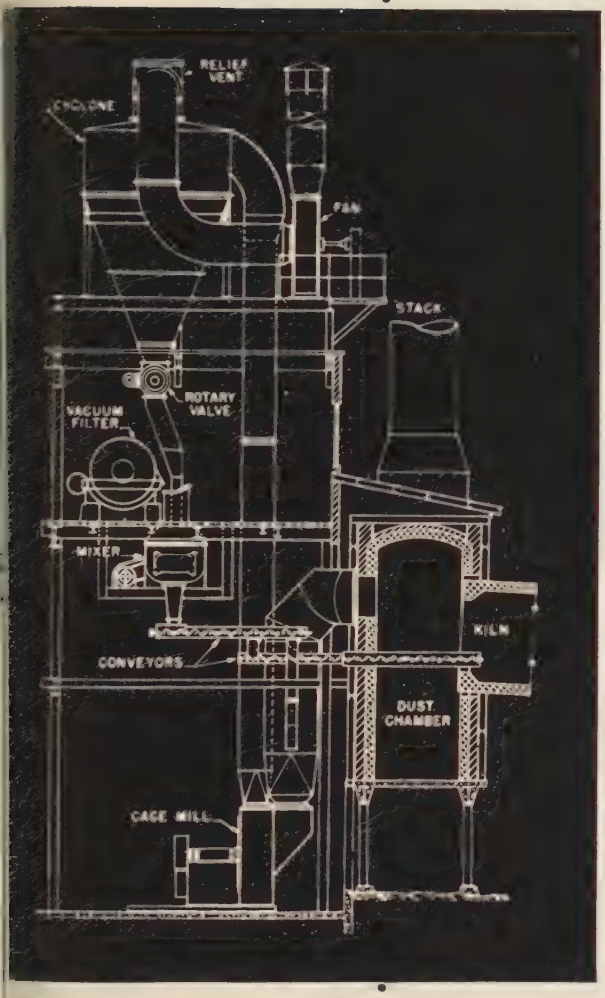

PRODUCTION OF SPECIAL INDUSTRIAL, SANITARY, TISSUE & ABSORBENT PAPERS
THOUSANDS OF SHORT TONS
SANITARY TISSUE PAPER
SPECIAL INDUSTRIAL PAPER
TISSUE PAPER (EXCEPT SANITARY)
ABSORBENT PAPER
1949
1950
1951
1952
1953
1954

PRODUCTION OF COARSE PAPERS AND CONTAINERBOARD
THOUSANDS OF SHORT TONS
PRODUCTION - CONTAINER BOARD
PRODUCTION - COARSE PAPER
1949
1950
1951
1952
1953


PRODUCTION OF FOLDING BOXBOARD, SET-UP BOXBOARD, SPECIAL FOOD BOARD & MISCELLANEOUS PAPERBOARD
THOUSANDS OF SHORT TONS
FOLDING BOXBOARD
MISCELLANEOUS PAPERBOARD
SPECIAL FOOD BOARD
SET-UP BOXBOARD
1949
1950
1951
1952
1953
1954


PRODUCTION OF CONSTRUCTION PAPER AND BOARD
THOUSANDS OF SHORT TONS
CONSTRUCTION PAPER
CONSTRUCTION BOARD
1949
1950
1951
1952
1953
1954

EVER SEE A KILN STRETCHER ?



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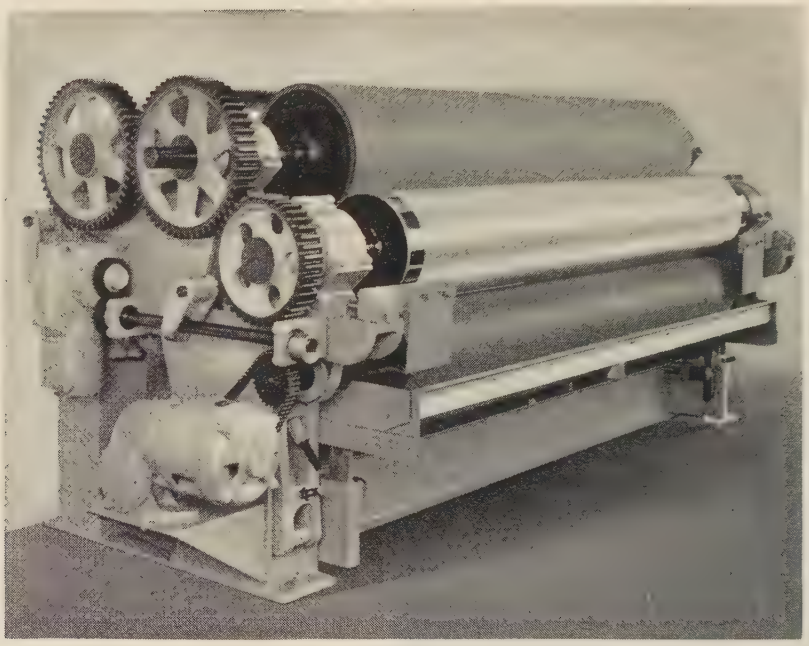

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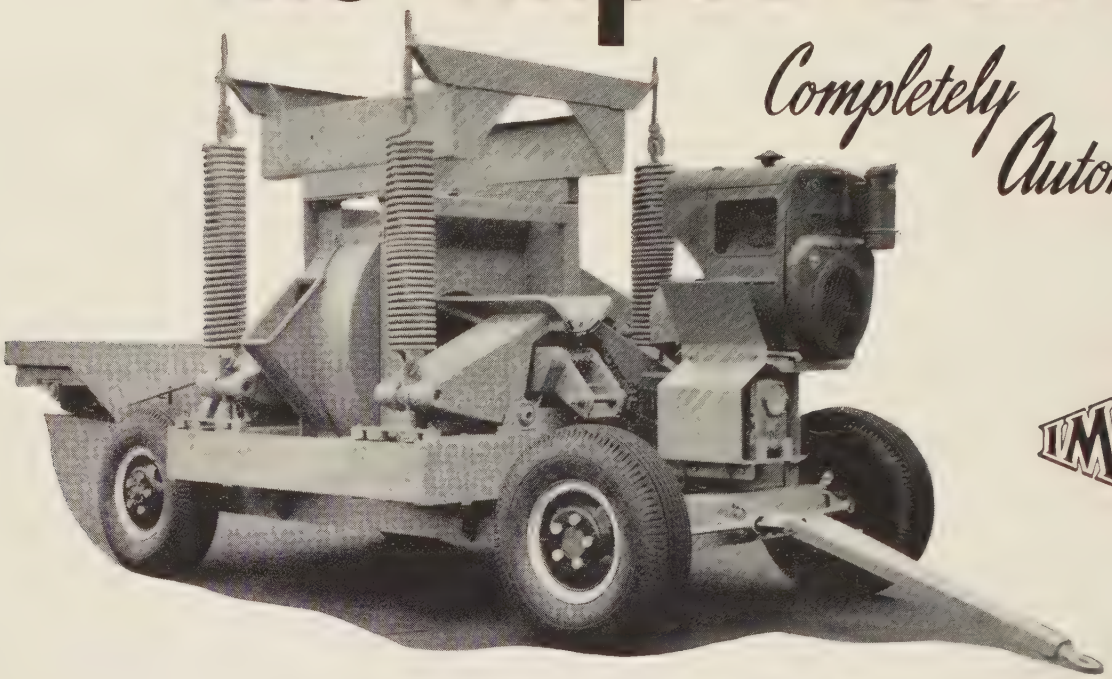

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Comparative Analysis of Digester Corrosion Measurements*

A. UNGAR and T. E. CAYWOOD

The problem of corrosion in alkaline pulp digesters has been examined in detail through the analysis of pertinent data from 198 digesters, submitted by 29 mills to the Technical Association of the Pulp and Paper Industry. The data consisted of sequential digester thickness measurements and information concerning digester construction and operating conditions. Corrosion patterns in terms of directional variations in corrosion rates were determined for 102 digesters. Local and over-all corrosion rates were calculated. Statistical techniques were used to test hypotheses concerning the effects on corrosion rates of materials of construction, age of digester, mill process, and other operating variables. Tests based on limited data indicated a significantly higher corrosion rate for: (1) Post-1940 digesters, of low and intermediate tensile strength ("ordinary") steels, compared with similar digesters installed earlier. (2) Modern-rimmed (A285B) steels compared with old-rimmed (pre-1930) steels. (3) Digesters in neutral sulphite production compared with kraft digesters at the same mill. The results of tests concerning the effect of alloy linings were inconclusive. No significant differences were found between: (1) Post-1940 digesters of ordinary steel and either old or modern-rimmed steel digesters. (2) Post-1940 digesters of ordinary steel and high-tensile strength steel digesters. (3) The kraft and soda processes. (4) Direct and indirect heating. (5) Forced and natural circulation. (6) Geographical locations.

This is a report of an extensive comparative analysis performed on data submitted to the Digester Corrosion Subcommittee of the Chemical Engineering Committee of the Technical Association of the Pulp and Paper Industry by 29 cooperating mills. The great bulk of the data was supplied by alkaline pulp mills, and the analysis has concentrated on these. The data consist of over 41,000 digester wall-thickness measurements and voluminous information on digester construction and operating conditions. The purpose of the analysis was to calculate corrosion rates, to look for patterns of corrosion, and to assess the comparative effects of pertinent variables on corrosion in alkaline digesters. Because of the confidential nature of the information, individual mills are referred to by code letters.

The project grew out of a widespread belief in the industry that corrosion in wood pulp digesters, in the last decade, has become a more serious problem than it had been previously. It is clear to mill operators that corrosion rates in certain digesters have increased, and the problem is generally considered so important that intensive efforts are being made to identify the factors that contribute to corrosion and to evaluate their relative importance.

The Digester Corrosion Subcommittee has been engaged in investigation of the corrosion problem since 1950 (*9, 13, 14*). It plans to continue the study of the data thus far available to it, supplemented by further information where this is necessary. The problem is being studied simultaneously by individuals and by industry-wide operational methods in Canada, Sweden, and Australia.

A. Ungar, Associate Engineer, Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.; and T. E. Caywood, formerly Supervisor, Operations Research Section, Armour Research Foundation, at present, Caywood-Schiller Associates, Chicago, Ill.

* The report was prepared under the sponsorship of the Chemical Engineering Digester Corrosion Subcommittee through TAPPI Research Project no. 9.

NATURE OF THE DATA

Categories of Submitted Data

The data collected by the Subcommittee fall into a number of categories:

1. Periodic inspections of digesters.
   a. Surveys of the thickness of the digester wall, two to eight sets of sequential readings per digester.
   b. Schematic drawings showing the type and pattern of corrosion, drawn from visual examinations of the digesters.
2. Digester specifications.
   a. Drawings and dimensions of digesters, including location of fittings, weld seams, etc.
   b. Materials specifications: physical and chemical data.
3. Process variables.
   a. Chemical data: cook compositions, sulphidity, make-up chemicals, etc.
   b. Physical data: type of cooking controls, methods of heating and chip loading, etc.

Most mills reported thickness measurements on a form recommended by TAPPI (*1*). This form is a schematic representation of the inspection grid within the digester, and the data are recorded at points corresponding to their location in the digester. Details of digester construction and process variables were supplied in answers to two questionnaires (Tables VII and VIII) sent out by the subcommittee. A detailed critical evaluation of the assembled data is presented in Appendix I—Data.

A summary list of digesters by mill, geographical location, and class of steel is presented in Table I; all of the digesters on which data were received are listed.

Relatively frequent and detailed surveys of digester wall thicknesses have been made economically feasible by the availability, since 1949, of a nondestructive, sonic measuring device, the Branson Audigage (*2*). Other similar instruments are available, but all of the thickness measurements considered in this study were obtained with the Audigage. The principles of operation, characteristics, and reproducibility of this instrument are described in the manufacturer's instruction books.

Discarded Data

Data on 198 digesters from 29 mills were received. Of these, 89 digesters in 12 alkaline mills were included in the general analysis. There were sufficient data from five additional alkaline digesters to permit determination of directional corrosion variation, though valid corrosion rates could not be calculated for these. Limited analyses were performed on one prehydrolysis

Table I. Summary Survey of Digesters by Material of Construction, Mill Process, and Geographical Area

Mill	Location	Mill process	Number of digesters — Construction material[a] — Ordinary steel 1930–40	Ordinary steel 1941–53	Rimmed steel 1900–30	Rimmed steel 1951–53	HTSc	Alloy	Unspecified	Total	Included in comparative analysis	Numb thick read
A	NE	Soda	..	..	2	..	..	..	..	2	2	3
B	SE	Kraft	..	8	..	..	..	..	7	15	8	1,9
C	SC	Kraft	..	8	..	3	..	2	..	13	13	7,6
D	SC	Kraft, neutral sulphite	4	7	4	..	..	..	..	15	14	1,5
E	SE	Neutral sulphite	..	..	..	..	..	5	..	5	0	2
F	SE	Kraft	10	18	..	..	3	7[b]	..	38	28	16,0
G	SE	Prehydrolysis	..	..	..	..	..	1	..	1	0	3
H	SE	Kraft	1	1	4	2	..	..	..	8	8	3,9
I	SE	Kraft	..	6	..	..	2	..	..	8	0	
J	NE	Soda	1	..	6	..	..	..	..	7	7	2,8
K	NE	Soda	2	..	1	..	..	..	..	3	0	1,5
L	NW	Kraft	..	1	1	..	..	..	..	2	2	
M	NE	Soda	5	..	..	..	..	..	..	5	1	3
N	SE	Kraft	2	..	..	..	..	..	1	3	2	6
O	NE	Kraft	..	2	..	..	..	..	..	2	0	2
P	SE	Kraft	4	..	..	..	..	..	..	4	4	1
Q	SE	Kraft	..	2	..	..	..	2	..	4	4	1,6
R	SE	Kraft	..	8	..	..	..	..	..	8	0	6
S	SC	Neutral sulphite	..	..	..	..	..	6	..	6	0	1
T	SE	Neutral sulphite	..	..	..	..	..	8	..	8	0	
U	SC	Neutral sulphite	..	..	..	..	..	5	..	5	0	
V	NC	Kraft	..	8	..	..	..	..	..	8	0	
W	NC	Kraft	..	2	..	..	..	..	..	2	0	
X	NE	Soda	1	2	..	..	..	..	..	3	0	1
Y	NW	Kraft	..	..	..	..	..	4	..	4	0	
Z	NC	Kraft	1	2	..	..	..	2	..	5	0	
AA	NW	Kraft	..	..	..	..	..	..	3	3	0	1
BB	NC	Soda	..	..	..	..	..	..	5	5	0	1
CC	SE	Kraft	..	6	..	..	..	..	..	6	0	
Grand Total			31	81	18	5	5	42	16	198	93	41,0

[a] See discussion of classifications.
[b] One of these carbon brick lined.
[c] High-tensile strength steel.

and seven neutral sulphite digesters for which data were submitted. The results for these are in Table IX, principally. A single interesting comparison between processes was made possible in one instance of a mill which operated both kraft and neutral sulphite digesters.

There was a scrupulous effort to use the maximum amount of data possible. Some of the reasons for discarding data might be instructive. One or more digesters were eliminated from the analysis for each of the following reasons:

1. Only one set of thickness data was supplied. This was done undoubtedly in the belief that these readings, together with the nominal original thicknesses of the digester plates, would be sufficient for the calculation of corrosion rates. However, it is believed that the steel mill specifications alone are not sufficiently accurate to justify this procedure.
2. Too few points were inspected to permit a statistical analysis of the data. In some cases as few as three or four points were inspected, in others none at all.
3. Sequential readings were not taken at the same locations.
4. Sets of readings indicating a gain in thickness of the digester wall showed a probability much too small to be accounted for by random error. In some of these cases a systematic error in the measuring instrument or in procedure was indicated.
5. One mill reported no corrosion problem and, therefore, did not supply any thickness readings, although a mass of other data was submitted.

Method of Locating Points

In a number of cases the inspection procedure was described in detail, although most mills did not provide this information. Some mills expressed doubt regarding the accuracy of their own methods of relocating points. In these instances, and in others, the internal evidence of the data sometimes indicated questionable accuracy in the relocation procedure, but lacking further definite evidence regarding their lack validity, these data were retained.

One of the more careful techniques encountered one that has been described by N. Shoumatoff (In this procedure eight equally spaced studs were we to the interior of the vessel around the top of the sh From these studs, chains, with washers inserted at re lar intervals, were suspended. The inspection po were located by inserting the sensing device of the A gage into the openings of the washers.

SCOPE OF ANALYSIS

The analysis encompassed the study of certain effi pertinent to digester corrosion within each dige within each mill, and among all the mills. These w

A. For each digester.
   1. Test for significance of vertical and horizontal ation of corrosion rates.
   2. Calculation of average corrosion rates at each spected height in digester.
   3. Average corrosion rate for the entire vessel.
   4. Vertical position of maximum of corrosion rates fro
B. Within mills.
   1. Differences between alloy-lined and carbon stee gesters.
   2. Differences among digesters with different carbon specifications.
   3. Differences among classes of steel. There are a n ber of subgroups under this heading. They inc comparisons among digesters of low and intermed tensile strength steels, digesters of high-ten strength steels, and digesters known to be of rim steel.
   4. Effect of age on corrosion resistance.
   5. Kraft versus neutral sulphite operation where occurs in the same mill.
C. Among mills.
   1. Kraft versus soda process.
   2. Forced versus natural circulation.
   3. Direct versus indirect heat.
   4. Effect of geographical location.

DISCUSSION OF RESULTS

nalysis of Variance

In order to test for vertical and/or horizontal varia-ons in corrosion rate, a two factor analysis of variance* as performed for each digester on the difference in ickness between the first and last inspection at each spected location in the digester. This was one tech-que among a number of possibilities, of finding indi-tions of the pattern of corrosion variation. Every mbination of significant variation in the horizontal d vertical directions (on the 0.95 probability level), lack of it, was found. The results of this analysis e summarized in Table II.

ble II. Summary of Internal Variation Character of Alkaline Digesters

ection of significant riation in corrosion tes → Mill	Number of digesters: None	Vertical	Horizontal	Both
A	..	2	..	..
B	4	2	1	1
C	..	4	3	6
D	11	..	..	..
F	2	18	2	7
H	1	7	..	..
J	..	5	1	1
K	3	..	..	..
L	2	..	..	..
M	..	1	..	..
N	..	2	..	..
P	3	1	..	..
Q	1	1	..	2
Total	27	43	7	17

As might have been expected, because of the general mmetry of stationary digesters about a vertical axis, e largest class consisted of those digesters with vertical riation only. The results for individual digesters e to be found in Table IX.

No industry-wide pattern was found, but, in most ses, results sure to be of interest to individual mills nerged. For example, all but one digester at mill D splayed statistically homogeneous corrosion in both rections, whereas an unusually large proportion of the gesters at mill C showed horizontal inhomogeneity. n general, each mill tended to display some character-tic pattern, with respect to either one direction or oth. A careful examination of design and operational ata may permit correlation of the pattern with one more attributes of the mill. For example, if a ationary digester shows significant horizontal varia-on in corrosion, some asymmetric factor such as chip npingement during loading may be suspected as the use.

cal Corrosion Rates

The measurements in each row of the inspection grid ere pooled to obtain an estimate of the row corrosion te (slope regression coefficient). The horizontal rection was chosen for pooling because most of the gesters showed no significant horizontal variation. would have been of some interest to calculate pooled timates in the vertical direction of corrosion rates for ose few digesters with significant variation in only

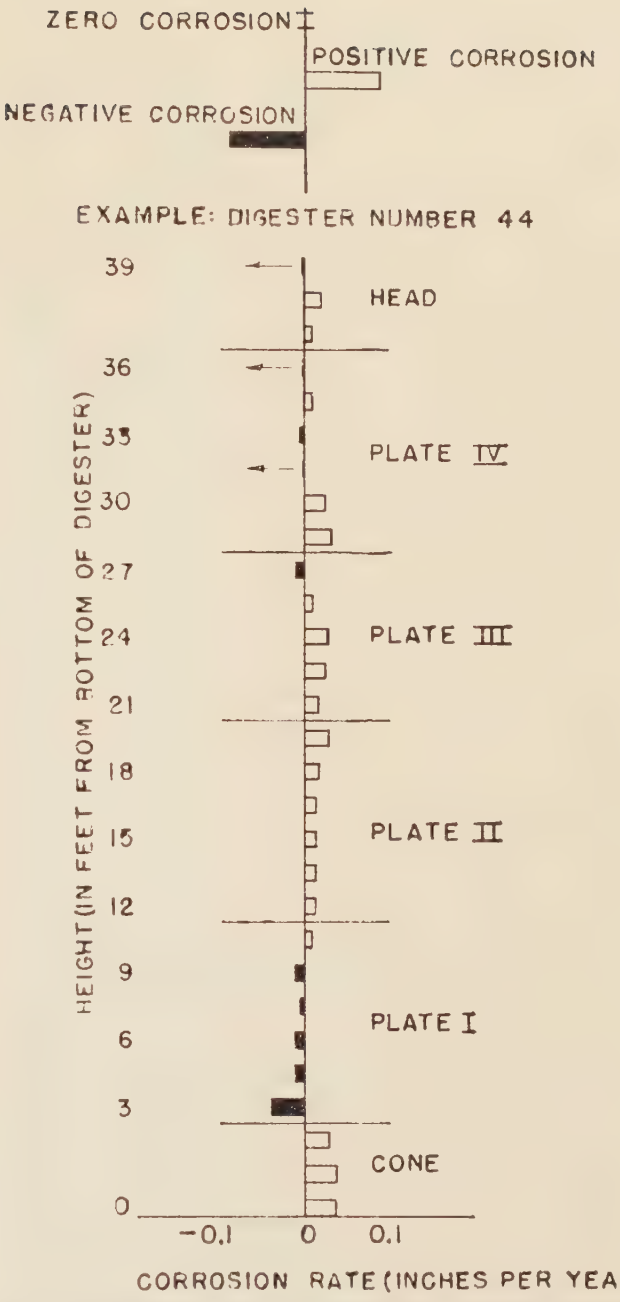

Fig. 1. Corrosion rate versus height in digester (digesters with significant variation of corrosion rate between rows, but not between columns, of inspection grid)

the horizontal direction, but time limitations did not permit this. It should be understood that these row corrosion rates have different meanings, depending on the pattern of variation within the digester. In those cases in which there is no directional variation, the row corrosion rates may be regarded as independent estimates of an over-all digester corrosion rate. When only vertical variation exists, the row corrosion rates may be regarded (with allowances for the statistical variation in the data) as a profile of this variation. The row corrosion rates for these digesters are plotted against height in the digester in Figs. 1 to 12. These corrosion rates were inspected carefully for significant patterns of variation, perhaps characteristic of a mill, but no unambiguous cases were found.† Finally,

* This technique is described in detail in books on statistical analysis, e.g., Hald (4), p. 412 ff.

† For those interested in examining this question in more detail there exist statistical techniques in the areas of curve fitting and testing of hypotheses concerning goodness of fit. See, for instance, A. Hald (4).

Fig. 2. Corrosion rate versus height

when horizontal variation is found to exist, the horizontal corrosion rates have limited value as indicators of local corrosion rates, since in these cases relatively small areas have a disproportionately great effect on the calculated corrosion rates.

Some of these row corrosion rates were tested for nonlinearity, i.e., change with respect to time. The few indications of nonlinearity which were encountered were considered questionable and were attributed to lack of independence in the data. This question is discussed in more detail in Appendix I—Statistical Techniques.

Table III. Location of Peak Corrosion Rate

Mill	Number of digesters: Top head	Upper shell	Middle shell	Lower shell	Bottom head
A	..	..	..	2	..
B	..	2	3	3	..
C	..	6	5	2	..
D	1	2	1	1	6
F	8	7	6	1	6
H	3	4	1	..	..
J	..	1	1	3	2
K	..	1[a]	1	1[a]	1
L	..	..	1	..	1
M	..	1	..	..	..
N	..	1	..	..	1
P	..	..	4	..	..
Q	..	4	..	..	..
Total	12	29	23	13	17

Average peak corrosion rate: 102 mils per yr.

[a] Peak corrosion occurs in two places in one digester.

The vertical location of maximum row corrosi one of five zones—top head; upper, middle or shell; and bottom head—is tabulated for each dig in Table IX. Table III summarizes these r by mills. This table and its interpretation are d N. Shoumatoff and H. O. Teeple (*11*). Shoum and Teeple point out that the largest group of dige show peak corrosion in the upper and middle pa the shell, and that the next largest group corrode severely in the bottom head. They associate the corrosion with interface phenomena, such as turbu or hot plate boiling, rather than with vapor phase at The corrosion in the bottom head is attributed to er caused by the blowing of the digester.

Comparison of Variables of Interest

The comparisons tabulated and discussed in th port are confined to those regarding which stati tests could be made. There is no doubt that a ca consideration of other comparisons, not susceptib statistical test, made by individuals with an inti knowledge of the paper pulp industry, would su fruitful directions for future study. This is espe true where experience and observation support inferences. However, the dangers inherent in dra definite conclusions from what is to an appre extent a subjective procedure must be kept in mind

A "significant" result in a test implies a high d of likelihood that the effect under test is a real on was not caused by purely random variation ("er in the data. It follows that important differences test "significant" most of the time. On the other h

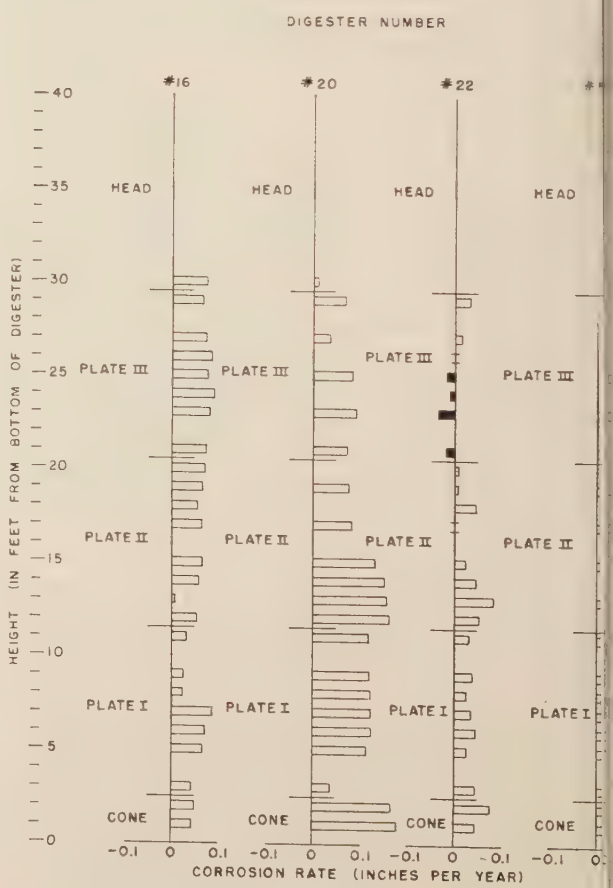

Fig. 3. Corrosion rate versus height

"not-significant" result states merely that significance as not found. It does not "prove" that the opposite ate exists, namely, that there is no real difference etween the groups being compared. It is important o point this out in the present situation, where a class f relatively insensitive tests had to be used (see Appendix I—Statistical Techniques). Thus, a single ot-significant result need not rule out further investiation provided experience strongly suggests a real fect.

Only primary effects were considered in the follow- g series of tests. One can generally expect to en- unter interactions of some importance among as ge a number of variables as were encountered in the esent study. Although time limitations did not per- it a detailed consideration of this question, extensive ork with the data left the impression that appreciable ditions to the raw data presently available would be quired for an effective study of interactions.

The average corrosion rate for each digester was used the basis of these comparisons. These corrosion tes are listed in Table IX, while Appendix I treats e statistical techniques used in detail. Tables IV d V summarize the results of the comparisons, and ppendix II lists the code numbers of the individual gesters included in these comparisons.

omparisons Within Mills

Class of Steel and Age. Originally it was planned to assify steels according to whether they were fully lled, semikilled, or rimmed, using the ASTM specications to indicate the appropriate class. During e course of an extensive correspondence with R. A. Davis, Chicago Bridge & Iron Co., H. F. Peters, Lukens Steel Co., and N. Shoumatoff, West Virginia Pulp & Paper Co., it became clear that such a classification would be incorrect. There is good reason to believe that many of the digesters installed in the 1930's and 1940's, with specifications that would have identified them as semikilled steels, might, in fact, have been rimmed and, in some cases, even fully killed. The following facts were agreed upon among the correspondents:

1. Digesters installed before 1930 (and in one specific instance, in 1930) are in the rimmed class, and will be referred to here as "old-rimmed."
2. Digesters of A285B steel, further specified as "rimmed" or "modified," generally installed in 1951 and 1952, were made in an attempt to duplicate the old-rimmed class, and will be referred to as "new-rimmed."
3. Digesters of ASME S-1, and ASTM A89, A70, and A285C steels, installed during and after 1930, may be rimmed, semikilled, or fully killed. The A285B digesters, without further specification regarding degree of deoxidation, also were placed in this group. These are pressure vessels of low and intermediate tensile strength, here designated as "ordinary" steels.
4. Digesters of A212B steel are high-tensile strength, high-silicon, high-carbon steels, and are here designated "HTS."
5. Reliable information about the degree of deoxidation of a steel can be obtained only by chemical analysis.

It was further decided to divide the ordinary digesters into two age groups, old-ordinary, if they were installed before Jan. 1, 1941, and new-ordinary, if they were installed after this date. This date was chosen as an appropriate dividing line between periods of moderate and accelerated production rates and the emergence of other factors which may have contributed to an increase in corrosion rates.

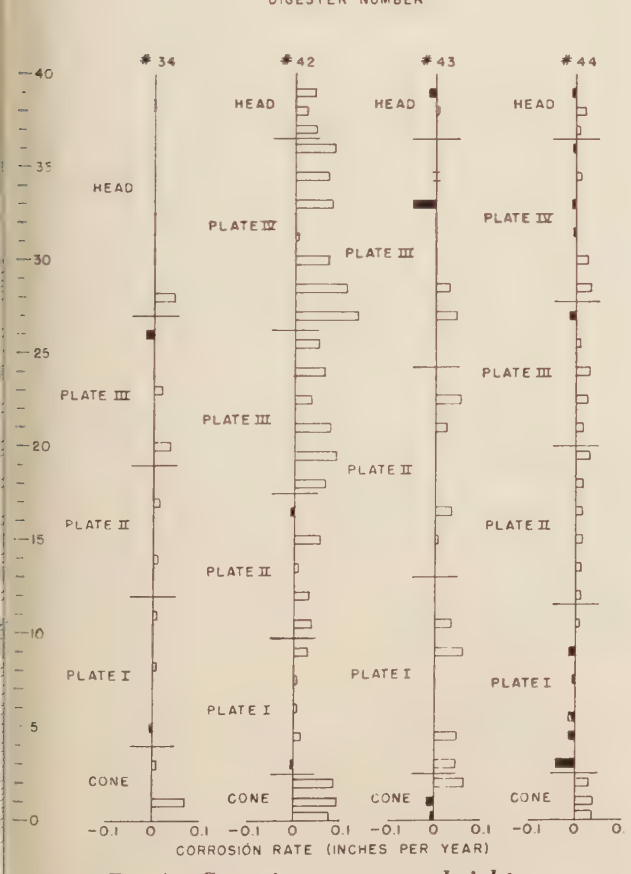

Fig. 4. Corrosion rate versus height

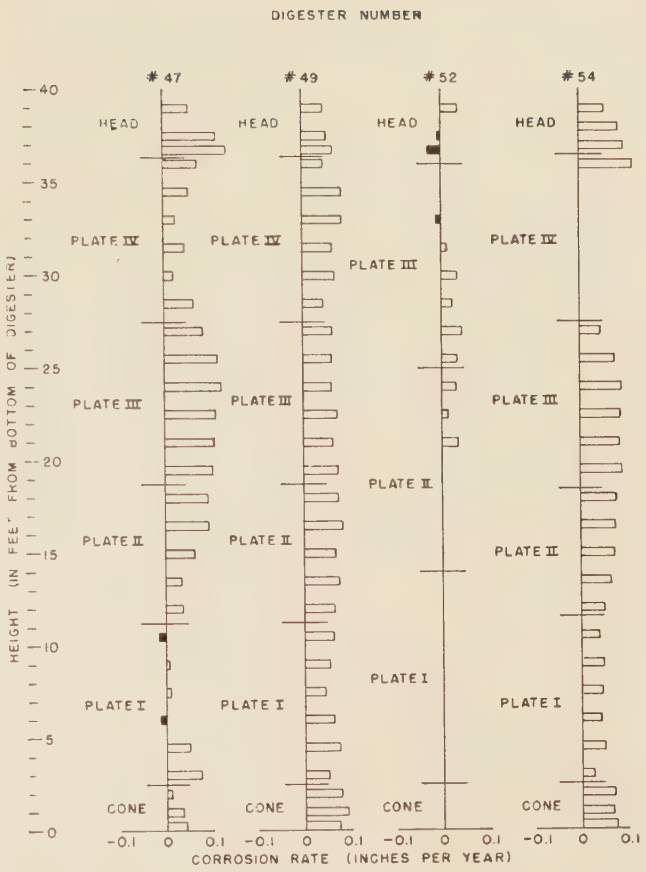

Fig. 5. Corrosion rate versus height

Table IV. Summary of Comparisons Within Mills

Test no.	Comparison	Mill	Number of digesters in sample	Average corrosion rate, mils/yr.	Results[a]
		Age and Class of Steel			
1	Old-ordinary	F	9	22	S
	New-ordinary		12	41	
2	Old-ordinary	H	1	2	S
	New-ordinary		1	23	
3	Old-rimmed	H	4	12	S
	New-rimmed		2	56	
4	New-ordinary	C	8	62	NS
	New-rimmed		3	66	
5	Old-rimmed	D	4	12	NS
	New-ordinary		6	14	
6	Old-rimmed	L	1	10	NS
	New-ordinary		1	20	
7	High-tensile	F	3	57	NS
	New-ordinary		12	41	
		ASTM Number			
8	A285C	B	4	40	NS
	A70		4	34	
9	A285C	D	2	23	NS
	A70		4	10	
	A89		4	12	
		Alloys versus Carbon Steels			
10	Inconel, 410SS	C	2	7	S
	New-ordinary		8	62	
11	Inconel	F	3	23	NS
	New-ordinary		12	41	
12	347SS	Q	2	26	NS
	New-ordinary		2	32	
		Kraft versus Neutral Sulphite			
13	Kraft	D	10	13	S
	Neutral sulphite		4	40	

[a] S—significant; NS—not significant.

Among the differences found in this group was a significantly lower corrosion rate for old-ordinary, compared to new-ordinary, digesters at mills F and H. This limited evidence appears to support the belief that ordinary steels made since 1941 have decreased corrosion resistance. This indication certainly merits further study in the laboratory.

A single comparison of old-rimmed with new-rimmed steels, at mill H, showed superior corrosion resistance in the older group. This was the only statistical comparison possible in this class. It would be interesting to make similar comparisons in other mills if supplementary data could be obtained.

One comparison of new-rimmed with new-ordinary steels did not indicate significant differences between these groups. Two tests of the difference between old-rimmed and new-ordinary steels also failed to show significance. Because of the limited number of new-rimmed steels in the sample and the contradictory results of the collateral tests, it would be difficult to draw conclusions regarding the relative corrosion resistance of the modified A285B steel.

A single comparison of the high-tensile steel, A212B digesters at mill F with the new-ordinary digesters at the same mill failed to support the hypothesis that the former group have lower corrosion resistance than the latter. In view of the indications of laboratory studies supporting this hypothesis (*5*), this question should be examined further.

ASTM Specifications. Logic dictated that comparisons be made on the basis of the classes previ cited in preference to ASTM classifications a However, two comparisons, which did not fall str in any of the former group, were possible. At m comparison of a group of four A70 digesters install 1945–47, with an equal number of A285C diges installed in 1950–51, revealed no significant differ At mill D the comparison is among groups of rimmed A89A's installed in 1930, and ordinary A dating to 1941 and A285C's installed in 1950. A no significant difference was found. These tests gest that no important change occurred when A285C specification succeeded the A70. Over-all rosion rates, grouped according to materials of struction of the digesters, are plotted in Fig. 13.

Alloy Linings versus Carbon Steel. Only a lin number of statistical comparisons of alloy-lined carbon steel digesters were possible. Because of and because the oldest alloy lining in this group c back to only 1949, the carbon steel digesters in the parisons were limited to those in the new-ordinary gr No statistically significant differences were found tween an Inconel and new-ordinary group at mi or between the 347SS and new-ordinary digester mill Q. At mill C there is a single Inconel-lined one 410SS digester. Tests of significance between t two digesters, as well as tests of each one separa against the group of new-ordinary digesters, were tempted, but the statistical requirements for these were not satisfied, so the preferred comparisons not feasible. It was possible to compare the two a lined digesters as a group with the new-ordinary gesters. The lined digesters displayed superior rosion resistance. The question of the effect of linings is left open by these comparisons, and fu studies with supplementary data are suggested.

Kraft versus Neutral Sulphite Operation. Alth the small number of neutral sulphite digesters rep were necessarily unrepresentative of this proces interesting comparison with some of these was poss Four of the 14 digesters in the sample from mill D changed in recent years from kraft to neutral sulp operation. Comparison of the corrosion rates of t four digesters in the recent period with the dige remaining in kraft operation permitted a test bet the two processes. The kraft digesters were foun have a significantly lower corrosion rate than tho neutral sulphite pulping.

In confining the comparisons in this section to gr within mills, the assumption was made that betw mill process differences might obscure the effects o

Table V. Comparisons of Process Variables

Test no.	Comparison	Number of digesters in sample	Average corrosion rate, mils/yr.	Re
14	Kraft process	79	33	
	Soda process	10	25	
15	Forced circulation	18	31	
	Natural circulation	67	33	
16	Direct heating	80	32	
	Indirect heating	9	35	
17	Northeastern mills	10	25	
	Southeastern mills	54	33	
	South-central mills	23	36	
	Northwestern mills	2	15	

[a] NS—not significant.

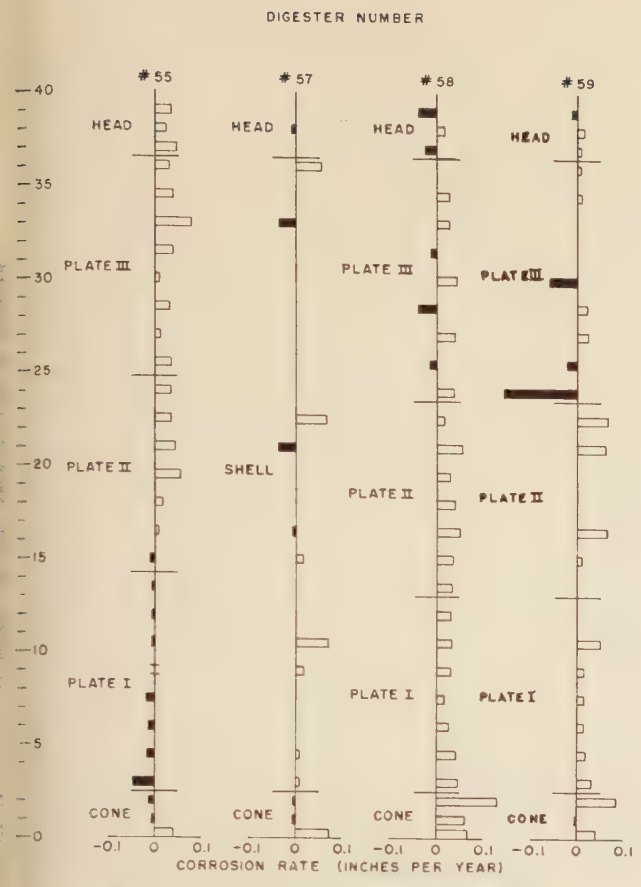

Fig. 6. Corrosion rate versus height

haracteristics under test. This assumption was tested tatistically (Appendix I) and was supported by the esults of the tests.

ests Among Mills

A number of accessible tests based on process and peration variables were made. These comparisons, ummarized in Table V, were between the kraft and oda processes, forced and natural circulation, and direct nd indirect heating. None of the differences were ound to be significant. Differences among the four eographical regions represented (the northeast, southast, central south, and northwest) were not significant ither. Corrosion rates, with digesters grouped by eographical location, mill, and process are plotted in igure 14.

Table VI presents average corrosion rates by mills, gions, and processes. The mill averages provide me basis for comparison between mills, although it ust be remembered that some real variations within ills have been attributed to specific factors, i.e., difrences in materials of construction. For this reason me of the mill corrosion rates represent the averaging f unlike objects, in a sense the averaging of apples and ears.

Only stationary and top-filled digesters were repsented in the analysis, and, therefore, no comparisons ere made on the basis of general type of digester and ethod of filling with chips.

RECOMMENDATIONS FOR FURTHER STUDY

Undoubtedly much light still can be shed on the problem of corrosion in alkaline digesters by further study of the data presently available to the subcommittee. This information, together with supplementary data which it may be necessary to obtain could be used for the following investigations:

A. Evaluation of the effect on relative severity of corrosion of process variables such as: (1) sulphidity levels, (2) composition of liquors, (3) type and amount of make-up chemicals, and (4) types of wood used.

B. Extension of the comparison of geographical regions to areas not represented in this analysis, and detailed comparisons within regions.

C. Evaluation of the effect of variation of chemical composition of digester steels.

Table VI. Average Corrosion Rates of Alkali Process Mills

Process	*Region*	*Mill*	*Average corrosion rate, mils/yr.* *Mill*	*Region*	*Process*
Soda	NE	A	54	25	25
		J	19	..	..
		M	15	..	..
Kraft	SE	B	37	33	33
		F	35	..	..
		H	23	..	..
		N	25	..	..
		P	40	..	..
		Q	29	..	..
	SC	C	54	36	..
		D	13	..	..
	NW	L	15	15	..
Soda and kraft	..	..	..	..	31

D. Further study of the question of nonlinearity in corrosion rates.

E. Correlation of local variation of corrosion rates

Fig. 7. Corrosion rate versus height

within digesters with details of design and such factors of operation as chip loading and blowing.

F. Study of the variability associated with the thickness-measuring technique and comparison of this variation among mills.

G. Study of the problem of predicting digester service life, which was not attempted in this analysis.

H. Investigation of possible alternative statistical techniques more sensitive than those used to test hypotheses in the present study.

SUMMARY

The enthusiastic cooperation of the 29 mills taking part in this study resulted in the collection of a large mass of pertinent data concerning the problem of corrosion in alkaline digesters. It is believed that much useful information has emerged from the present study. The following tentative conclusions are suggested by the work:

1. Digesters of ordinary steel installed since 1941 have lower corrosion resistance than the older ordinary-steel digesters.

2. The corrosion resistance of modern rimmed steel-digesters is not significantly different from that of new-ordinary digesters, but may be inferior to that of pre-1930 rimmed-steel digesters.

3. High-tensile-strength steel digesters were not demonstrated to be inferior in corrosion resistance to new-ordinary digesters.

4. No significant difference was found between the rates of corrosion of old-rimmed and new-ordinary digesters.

5. There was no significant change in corrosion resistance caused by the replacement of the A70 speci tion with the A285C.

6. With only a few alloy-lined digesters avail for comparison there seems to be some evidence fo superior corrosion resistance of Inconel- and/or 41 lined digesters to those of new-ordinary steel, th some contradictory evidence with respect to In and 347SS linings invites further work to settle question.

7. Digesters in neutral sulphite operation at mill corrode faster than those in kraft operation a same mill.

8. No significant industry wide differences found attributable to process (kraft or soda), typ circulation, method of heating, or location in an four geographical regions represented.

9. A study of directional variations of corr rate within individual digesters was made. Among possibilities of vertical or horizontal variation al both horizontal and vertical variation or directi homogeneity, the group of digesters exhibiting ver inhomogeneity alone was the largest of the Patterns characteristic of individual mills, undoubt representing design and physical engineering fa were found.

10. The height of maximum corrosion appea correspond to areas affected by factors such as bulence, hot plate boiling, and blowing of the dige (*11*).

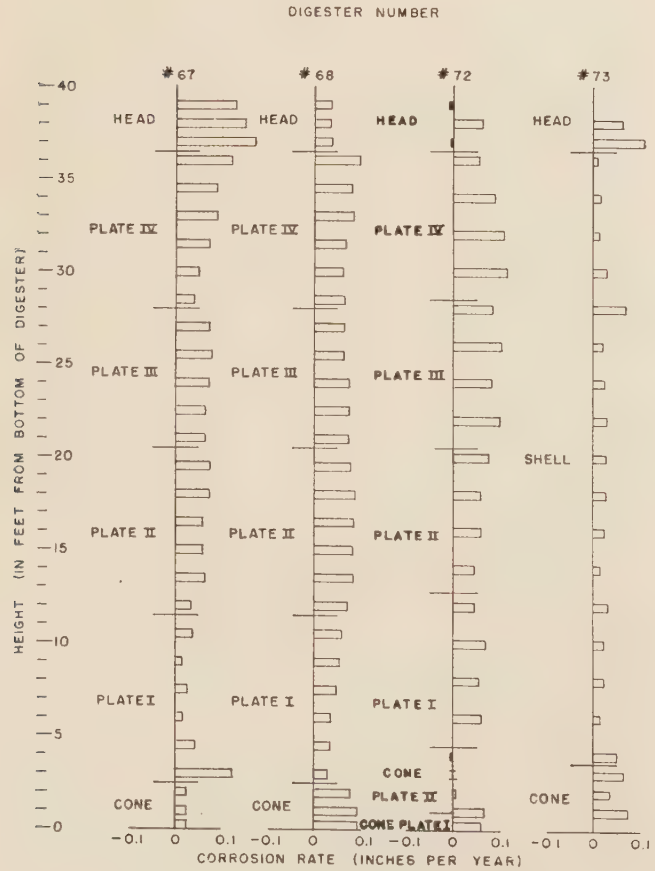

Fig. 8. Corrosion rate versus height

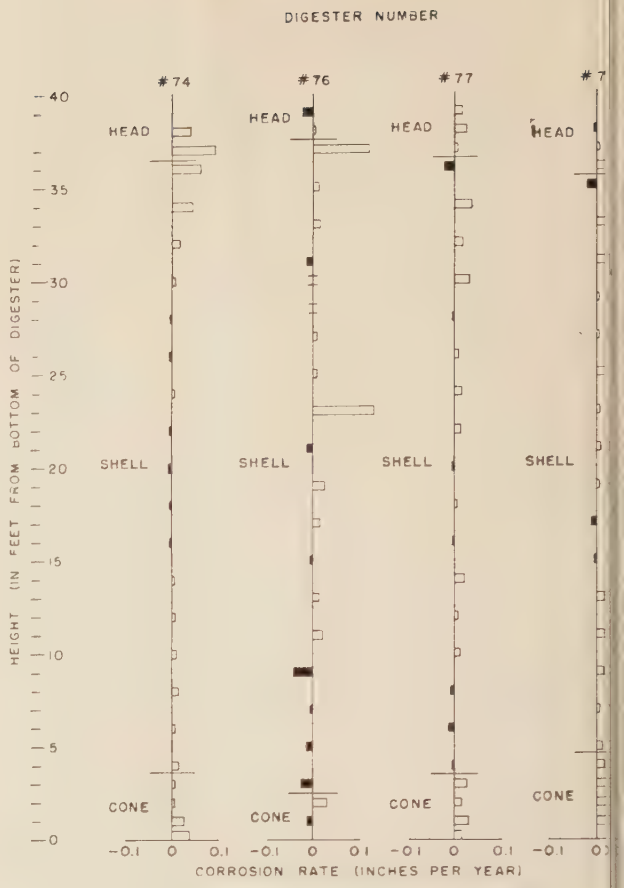

Fig. 9. Corrosion rate versus height

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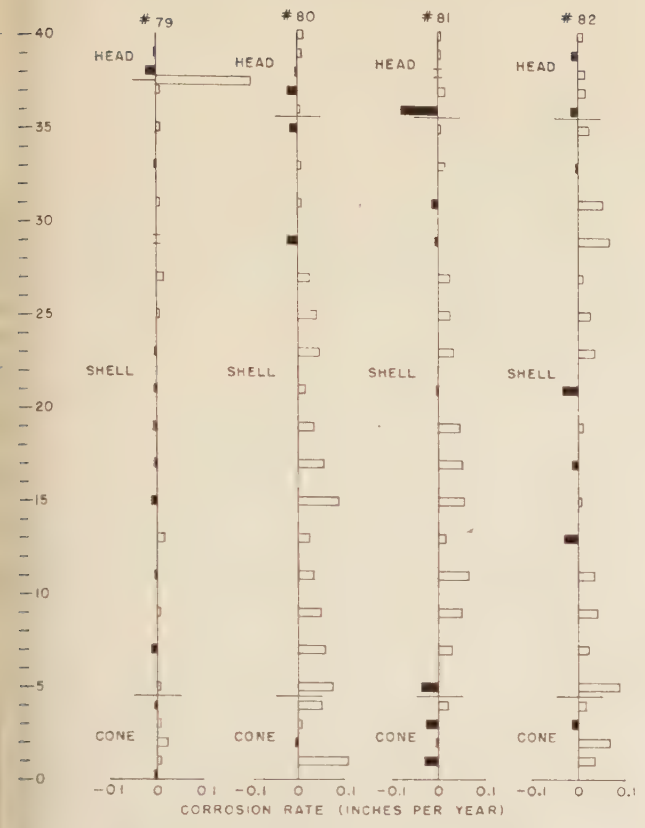

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The steering committee, consisting of N. Shoumatoff and H. O. Teeple have provided invaluable advice with regard to digester construction and mill operation throughout the course of this project. Armour Research Foundation personnel contributing materially to the analysis were Mrs. Ruth Barth Woodall, of the Operations Research Section, and C. E. Stewart and W. R. Thomas of the Computing Center.

APPENDIX I—DISCUSSION

Data

Thickness Measurements. The internal evidence of the raw data indicates that there is wide variation in the results obtained with the Audigage. This is not intended to be an evaluative statement regarding the instrument itself. No exact estimate of this variability was made. However, many examples may be cited, such as consistent apparent increases of thickness of 20 to 45 mils between inspections in several digesters. In one digester, for another example, a few feet from a spot that has apparently lost 340 mils of metal in 17 months, is another spot that has gained 190 mils in the same period. Without further evidence, the reasons for this can only be guessed. It may be that the characteristics of the instrument combined with varying degrees of care in its use among individuals have contributed to the situation. In any case, a number of suggestions may be made.

N. Shoumatoff (*12*) has performed an interesting experiment, by means of which he was able to compare the performance of two operators using the Audigage and to measure the reproducibility of the performance of each individual. This study could well be extended to a comparison of the techniques of operators at several mills. The aim of such a study should be the writing of industry-wide standards for the taking of thickness measurements. It would be of value to check the reproducibility of each operator against such standards. This general procedure not only would improve the reliability of the measuring programs within mills but also should facilitate the pooling of measurements be-

Fig. 11. Corrosion rate versus height

tween mills in the later stages of the subcommittee's present program.

Thickness surveys with the Audigage have been made as frequently as every 3 months over a period of a year, and as much as 17 months apart. On the average, they were made at 5 to 7-month intervals in the period covered by this study. This frequency appears to be adequate for the estimation of corrosion rates. However, with respect to operator and instrument it is quite infrequent. For this reason, it would be of value for each mill to have a test specimen of steel plate with carefully located points, to check instrument and operator before, and possibly after, each inspection period; it should be kept in the laboratory, or some other suitably available place. Although the manufacturer supplies users of the Audigage with a calibration standard, a more detailed standardization procedure seems justified. This procedure would serve to eliminate the occurrence of the sort of systematic error which invalidated some of the data in the present sample.

There should be industry-wide agreement as to the accuracy with which the Audigage will be read. Most

Fig. 12. Corrosion rate versus height

Table VII. Minimum Data for Each Digester

1. Mill
2. Digester number
3. Vessel manufacturer's name
4. Vessel serial no. or order no.
5. Date put in service
6. Diameter, ft.
7. Over-all height, ft.
8. Volume, cu. ft.
9. Shell height, ft.
10. Number plates in shell
11. Cone height or bottom head height (state which)
12. Top head type (flanged and dished, elliptical, etc.)
13. Type construction (riveted, forge welded, or fusion we
14. Digester type (stationary or rotary)
15. Nominal original thickness of stress bearing metal, in
    a. Top head
    b. Shell plate I
    (Read top II
    to bottom) III
    IV
    c. Bottom cone or head
16. Specification number of stress bearing metal
17. If alloy protection is used, give name and/or type nu special specifications if any, method of attachment (i rally clad, applied by welding in shop, or in field), portions of vessel are so protected, and nominal or thicknesses
18. If available, give chemical and physical test data for steel plate

mills record thicknesses to 0.01 in. and some to 0.00 while still others are inconsistent in their prac It is recommended that the Audigage be read to 0 in. The statistical techniques which are most u in analyzing the thickness records rely on a ran distribution of experimental error for their vali By rounding off his readings during the measuring cedure the operator introduces a nonrandom Should he, for any reason, wish to round off his num to two decimal places, this can always be done fro original records as the need arises.

Survey of New Digesters. The standard inspec grid should be laid out in all digesters before the placed in operation, and the first of the periodic th ness surveys should be made at this time. For most efficient use of statistical techniques, meas ments must be made under conditions reproduce closely as possible. Furthermore, there appears t appreciable variation in thickness over a plate. these reasons the nominal original thickness of the p or a single number based on this thickness, woul unsatisfactory in the calculation of corrosion rates.

Relocation of Points. This problem may be div into two parts. First, the question of accurately

Table VIII. Minimum Operating Data

For each inspection interval and wherever pertinent, for digester

1. Inspection dates at beginning and end of interval
2. Forced circulation used—yes or no (if yes, state locati inlet, top or bottom, also whether or not used while cha or filling digester)
3. Method of heating (direct or indirect)
4. Method of filling with liquor (whether from top or bot and whether before, after, or together with chips)
5. Type of cooking controls (if automatic, state make and
6. Number of cooks for each type of wood
7. Per cent sulphidity (TAPPI Std. O 400 p-44)
8. Per cent reduction (TAPPI Std. O 400 p-44)
9. Per cent recovery (TAPPI Std. O 400 p-44)
10. If convenient, give complete liquor analyses and quan of liquor and chips per cook
11. Type of make-up chemicals (soda, salt cake, sulphur, etc.), quantities of each used, and where added to syst
12. Pressure and cooking time per cycle

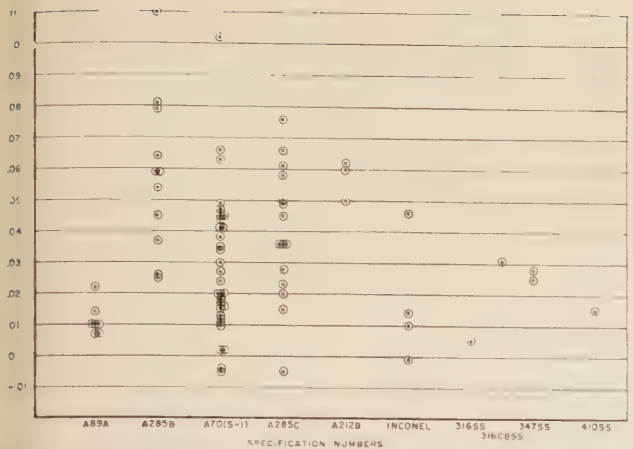


Fig. 13. Distribution of alkaline digester corrosion rates by ASTM, ASME, and AISI numbers

ating points from inspection to inspection should be udied carefully. The importance of this accuracy is lf-evident; a number of mills expressed doubts about ie accuracy of their own methods of relocation. This ight well be another subject for industry-wide study id the establishment of standards.

Second, every effort should be made to take readings onsistently at the same points, independent of the uestion of accuracy of relocation. An appreciable mount of data had to be discarded because out of two r more surveys in a digester only one measurement as made at some points; this was true of even those igesters the measurements of which were used in every hase of this analysis. It is expected that as the proram of measurements becomes better established, ractice in this respect will become more consistent. lowever, the situation should be mentioned.

Factors Contributing to Corrosion. Most of the comarisons made in the present analysis were made among roupings based on steel specifications. While these esults are expected to be valuable, a number of interesting variables remain to be studied.

In particular, it is suspected that chemical factors nave a most important bearing on the problem of orrosion. These factors include, among others: (1) hemical composition of the materials of construction, 2) sulphidity levels, and (3) composition of the cookng liquors.

Information in the first category thus far is scant and ppears to be expensive to obtain on digesters already n service. However, its probable importance weighs eavily in its favor. It should be easy to obtain this nformation with the purchase of new digesters, and very effort should be made to do this.

The available information in the second and third ategories presents special problems. While time limiations curtailed work on these factors, the impression vas nevertheless gained that analytical difficulties vould be caused by the type of data submitted. The lata generally available in these areas were average igures. Questions regarding the extent of variation nd methods, other than averaging, of treating these omposite numbers will have to be answered.

It is apparent that many aspects of the problem of orrosion in digesters remain to be studied. It is strongly recommended that the analysts be included among the original planners of any program contemplated for the future if the data are to be subjected to statistical analysis. Further, the analysts should be thoroughly familiar with the practical aspects of wood pulp manufacture, or if this is impossible provision should be made for them to become familiar with operation in the mills themselves. While this might appear to be a somewhat more expensive procedure than might otherwise be followed, it would prove to be economical in the long run, since a more efficient utilization of the data could be expected.

Statistical Techniques

This section deals in detail with the statistical techniques employed in the analysis. For generally excellent discussions of topics unfamiliar to the reader, he is referred to Hald (*4*) or Mood (*8*).

In most cases in which some form of mathematical analysis is to be applied to experimental data, the analyst has at his disposal a number of ideal mathematical models. It rarely happens, especially in the area of applicability of statistics, that any particular model exactly fits the physical reality. The analyst is then faced with the problem of choosing the model which, subject to practical considerations, best fits the data. Such was the case in the present instance.

The main body of the statistical analysis took the form of tests of hypotheses concerning the over-all regression coefficients, i.e., average rates of corrosion with respect to time of digesters in various classifications based on materials of construction and process variables. The sample points were taken to be these regression coefficients, and the null hypotheses generally stated that the samples came from normal populations with equal means and variances. Thus, tests 1, 3, 4, 7, 8, and 10–13 (Table IV) and 14–16 (Table V) were simple "Student's t"-tests of the equality of two means. Test 5 was a modified form of this test, using Welch's (*15*)‡ solution for the case of unequal variances. Tests 9 and 17 were F-tests. Tests 2 and 6 were the only ones in which advantage could be taken of the more sensitive class of tests based on regression theory. This form of the t-test is discussed by Hald (*4*), p. 571 ff.

‡ A more accessible discussion of this method may be found in Dixon and Massey (*3*).

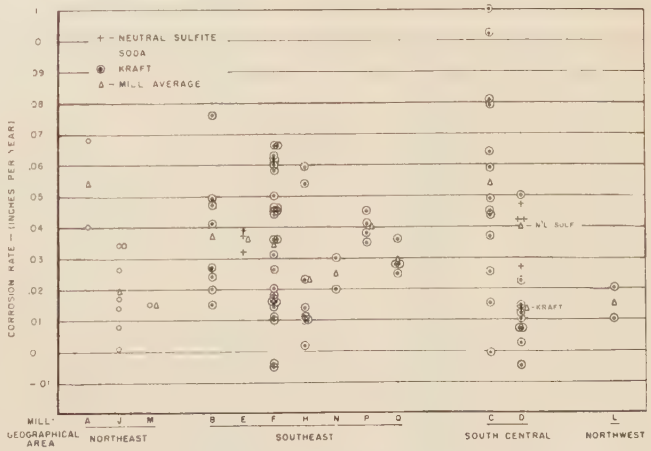


Fig. 14. Distribution of digester corrosion rates by mill, process, and geographical area

Wherever experience made it possible the 1-tail, in preference to the less sensitive 2-tail test, was used. For example, in the alloy lining versus carbon steel comparisons, the simple alternative hypothesis that alloys corrode more slowly than carbon steel the 1-tail test was applicable. In all tests the

Table IX. Characteristics of Digesters Included in Comparative Analysis

1	2	3	4	5	6	7	8	9	10	11	
Mill	*Digester no.*	*Date of installation*	*Number of inspections*	*Material of construction*[a]	*Type of circulation*	*Method of heating*	*Average number of inspection points*	*Over-all corrosion rate for vessel, mils/yr.*	*Maximum of row corrosion rates, mils/yr.*	*Location of maximum row corrosion*	*Type corro vari*
A	1	1900	2	Rimmed steel	F	D	40	40	169	LS	V
	2	1900	2	Rimmed steel	F	D	40	68	199	LS	V
B	3	11-51	3	A285C	F	I	71	76	143	MS	H
	4	1-45	2	A70	F	I	68	27	170	US	—
	5	6-45	2	A70	F	I	72	41	114	US	—
	6	5-50	2	A285C	F	I	63	49	88	MS	V
	7	1-47	2	A70	F	I	68	24	105	LS	V
	8	4-50	2	A285C	F	I	72	20	88	MS	—
	9	12-51	2	A285C	F	I	28	15	55	LS	V
	10	3-47	2	A70	F	I	52	47	125	LS	—
C	11	6-45[1]	2	A70	N	D	107	102	456	US	H
	12	3-50	4	410SS	N	D	135	15	81	US	H
	13	7-45[2]	7	A70	N	D	143	45	80	MS	H
	14	3-51	3	A285B	N	D	146	37	102	US	V,
	15	7-45[3]	8	A70	N	D	145	49	78	MS	V,
	16	3-51	2	A285B	N	D	162	59	92	LS	V
	17	8-45	7	A70	N	D	135	44	92	MS	V,
	18	12-50	3	Inconel	N	D	165	−1	3	LS	V,
	19	10-50	3	A285B	N	D	156	64	393	US	V,
	20	1-52	2	A285B	N	D	152	110	180	US	V
	21	12-51	2	A285B	N	D	168	81	136	US	V,
	22	2-51	2	A285B	N	D	160	25	83	MS	V
	23	2-52	2	A285B	N	D	144	79	114	MS	V
D	24	4-50	2	A285C	N	D	36	50	132	TH	—
	25	1941	2	A70	N	D	40	2	11	MS	—
	26[d]	4-50	2	A285C	N	D	32	X	X	US	—
	27	4-50	2	A285C	N	D	32	−5	23	LS	—
	28	1941	2	A70	N	D	36	10	41	BH	—
	29	1930	2	A89A	N	D	44	14	80	US	—
	30	1930	2	A89A	N	D	43	22	53	BH	—
	31	1938	3	A70	N	D	44	42	106	TH	—
	32	1938	3	A70	N	D	44	42	101	US	—
	33	1938	3	A70	N	D	44	47	98	BH	—
	34	1938	4	A70	N	D	44	27	66	TH	V
	35	1930	2	A89A	N	D	44	7	105	BH	—
	36	1930	2	A89A	N	D	43	7	42	BH	—
	37	1941	2	A70	N	D	44	13	92	BH	—
	38	1941	2	A70	N	D	44	12	42	BH	—
E	39	1944	2	..[b]	X	X	32	32	122	US	—
	40	1944	2	..[b]	X	X	32	37	104	BH	H
	41	1948	2	..[b]	X	X	32	39	174	BH	V,
F	42	3-50	3	A212B	N	D	109	50	138	US	V
	43	8-36[4]	2	S-1	N	D	136	20	64	BH	V
	44	2-51	3	Inconel	N	D	114	10	37	BH	V
	45	8-36[5]	2	S-1	N	D	216	X	X	X	V
	46	8-36[6]	3	S-1	N	D	124	−4	85	TH	H
	47	3-50	3	A212B	N	D	113	60	133	TH	V
	48	6-37	2	S-1	N	D	196	66	319	BH	V,
	49	3-51	4	A285C	N	D	122	66	92	BH	V
	50	6-37[7]	2	S-1	N	D	168	−5	47	LS	V
	51	6-51	3	Inconel	N	D	113	14	45	TH	V
	52	6-37[8]	2	S-1	N	D	93	18	37	TH	V
	53	3-51	3	A285C	N	D	109	36	226	TH	—
	54	3-50	4	A212B	N	D	136	62	114	US	V
	55	12-37[9]	3	S-1	N	D	225	16	79	US	V
	56	6-51	3	Inconel	N	D	109	46	93	TH	H
	57	6-37[10]	2	S-1	N	D	87	16	71	MS	V
	58	8-50	3	316CBSS	N	D	91	31	130	BH	V
	59	12-37[11]	3	S-1	N	D	139	63	84	BH	V
	60	3-52	4	A285C	N	D	124	61	120	US	V,
	61	12-37[12]	6	S-1	N	D	159	11	76	US	V
	62	12-42	5	A70	N	D	122	17	74	TH	V,
	63	12-42	5	A70	N	D	155	15	44	MS	V
	64	10-47	6	A70	N	D	153	46	68	US	V,
	65	10-47	7	A70	N	D	149	44	98	MS	V
	66	9-48	6	A285C	N	D	162	36	67	MS	V
	67	9-48	4	A285C	N	D	157	45	173	TH	V
	68	7-48	4	A285C	N	D	158	58	100	US	—
	69	5-52	3	A285B	N	D	107	45	160	MS	V,
	70	5-52	3	A285B	N	D	95	26	147	MS	V,
G	71	X	2	316SS	X	X	161	5	30	BH	V
H	72	4-52	2	A285B	N	D	190	59	117	US	V
	73	11-51	2	A285B	N	D	253	54	109	TH	V
	74	2-51	3	A285C	N	D	235	23	93	TH	V
	75	12-26	2	..[c]	N	D	176	14	71	US	—
	76	12-26	2	..[c]	N	D	184	11	131	MS	V
	77	10-29	4	A89A	N	D	186	10	38	US	V
	78	10-29	4	A89A	N	D	182	10	45	TH	V
	79	10-30	4	A70	N	D	188	2	200	US	V
J	80	10-23	2	..[c]	F	D	199	26	104	BH	V
	81	10-23	2	..[c]	F	D	198	8	64	LS	V
	82	10-23	2	..[c]	F	D	198	17	85	LS	V
	83	10-23	2	..[c]	F	D	195	1	96	MS	V
	84	10-23	2	..[c]	F	D	198	34	86	LS	H
	85	6-29	2	..[c]	F	D	172	14	68	US	V
	86	7-30	2	A70	F	D	191	34	79	BH	V,
K	87[d]	10-25	3	X	F	D	184	X	X	US, LS	—
	88[d]	8-30	3	X	F	D	170	X	X	BH	—
	89[d]	9-30	3	X	F	D	168	X	X	MS	—
L	90	5-29	4	A89A	N	D	12	10	234	BH	—
	91	6-44	2	S-1	N	D	15	20	60	MS	—
M	92	X	2	SS	F	I	89	15	43	US	V
N	93	4-38	2	A70	N	D	88	30	150	US	V
	94	4-38	2	A70	N	D	82	20	50	BH	V
P	95	3-38	2	S-1	N	D	20	35	50	MS	—
	96	3-38	2	S-1	N	D	20	45	57	MS	—
	97	3-38	2	S-1	N	D	20	41	54	MS	—
	98	3-38	2	S-1	N	D	20	38	58	MS	V
Q	99	6-49	2	347SS	X	D	128	28	52	US	—
	100	6-49	2	347SS	X	D	124	25	55	US	V
	101	3-48	2	A285C	X	D	193	36	57	US	V,
	102	3-48	2	A285C	X	D	210	28	46	US	V,

vel of confidence was used. This was a conventional hoice.

The tests which were employed, with the exception f nos. 2 and 6, were quite conservative. In a situation n which the potential number of degrees of freedom enerally ran in the hundreds, and quite often thousands t most only 87 degrees were utilized in any one test, nd the average number was less than 20.

Some discussion of the reasons for the adoption of the ver-all corrosion rate as the statistic of interest and the ass of tests employed seems to be in order. The ver-all regression coefficient is not entirely realistic om the point of view of the mill engineer since prob- ms of repair and replacement are generally con- cted with relatively small areas of intense corrosion. or this reason, various other possible statistics were nsidered. However, the alternative, choosing a nited area of some arbitrary size and of maximum rrosion rate, would have been more unrealistic at esent, since information on fixtures, the effects of osion, and other mechanical factors were sketchy. would have had the further disadvantage of ignoring ertinent data. This question should be re-examined any future study.

Having chosen the test statistic, it was necessary to amine the underlying assumptions of regression analy- s to see if the use of its techniques was justified.

These assumptions are: if y is the dependent vari- ble, and x is the independent variable,

1. For every value of x, y is normally distributed.
2. The mean value of y corresponding to a given value of x a linear function of x.
3. The variance of the y corresponding to a given value of x constant, or proportional to a given function of x.
4. The observations are stochastically independent.

In the present application time is the independent nd thickness is the dependent variable.

Condition (1) generally can be assumed to be met in mpirical situations such as the present. A number f tests for linearity were made on digesters for which our to eight inspections were available. The ratio f the variance of the observation means about the em- irical regression line (s_r^2) to the within-set variance of he observations (s_w^2) has the F-(variance ratio) dis- ribution.§ Thus, the test for linearity is an F-test ith k-2 and N-k degrees of freedom. The various atistics and symbols are defined:

$$s_r^2 = \frac{\sum_{i=1}^{k} n_i(\bar{y}_i - Y_i)^2}{k - 2} \qquad (1)$$

$$s_w^2 = \frac{\sum_{i=1}^{k}\sum_{j=1}^{n_i} (y_{ij} - \bar{y}_i)^2}{\sum_{i=1}^{k} n_i - k} \qquad (2)$$

§ See Hald (4), p. 535 ff.

$$\frac{s_r^2}{s_w^2} = F(k - 2, N - k) \qquad (3)$$

In equations (1) and (2) the index i refers to the distinct values of x, ranging in number from 1 to k. n_i is the number of observations (y_{ij}) corresponding to x_i. Thus

$$\bar{y}_i = \sum_{j=1}^{n_i} y_{ij}/n_i$$

and

$$N = \sum_{i=1}^{k} n_i$$

Y_i is the value of y corresponding to x_i calculated from the empirical regression equation.

Some instances of nonlinearity were found. Two objections to these results arose. First, the results were not consistent within a digester; that is, where the test was made on a number of horizontal corrosion rates at different heights within a digester, some indicated linearity, whereas others indicated decided nonlinearity. Second, plots of the allegedly nonlinear curves did not appear to support the evidence of the tests.

The explanation for these ambiguous results lies in what is believed to be widespread lack of stochastic independence in the data. Nonindependence will be caused, for example, by a systematic error occurring during one inspection of a digester, which has not occurred at other times, or has been different at other times. Evidence for this lack of independence lies in s_r^2. When serious lack of independence exists, the hypothesis of linearity will not be supported even if the observed phenomenon is linear. Theoretically, s_r^2 may be partitioned into effects due to nonlinearity and to nonindependence, but in practice this partitioning cannot be made, and the effects cannot be separated.

Consider, for the moment, b, the over-all corrosion rate about which the hypotheses of interest are to be formulated and tested. The conventional estimate of the variance of b, s_b^2, is

$$s_b^2 = \frac{s^2}{\sum_{i=1}^{k} n_i x_i^2 - \frac{\left(\sum_{i=1}^{k} n_i x_i\right)^2}{N}} \qquad (4)$$

where s^2, the variance of the observations about the empirical regression line, is defined in equation (5).

$$s^2 = \frac{(k - 2)}{(N - 2)} s_r^2 + \frac{(N - k)}{(N - 2)} s_w^2 \qquad (5)$$

Since s^2, and therefore, s_b^2 are seen to be functions of s_r^2, they are at the mercy of any nonindependence which may be present in the data.

The standard techniques for comparing two or more

ey to Symbols and Footnotes:
Type of Circulation: F—forced; N—natural. Method of Heating: D—direct; I—Indirect. Location of Maximum Row Corrosion: TH—top head —upper shell; MS—middle shell; LS—lower shell; BH—bottom head. Type of Corrosion Variation: V—vertical; H—horizontal; V, H—both vertical d horizontal; —only random variation; X—no information.
Dates of removal of digesters no longer in service: [1] 5-6-49. [2] 3-16-51. [3] 3-22-51. [4] 9-50. [5] 2-51. [6] 12-52. [7] 6-51. [8] 3-51. [9] 7-51. [10] 8-50. [11] 3-52. 12-52.
[a] Materials of construction are specified by ASTM and ASME numbers for unlined digesters, and lining materials by AISI numbers.
[b] Stainless steel spray.
[c] Old-rimmed steel.
[d] These digesters exhibited what appeared to be a systematic error in thickness measurements. While the calculation of corrosion rates would have been meaningless, it was still possible to determine the type of corrosion variation and the location of the row of maximum corrosion rate.

regression coefficients require that s^2 in each case be an independent estimate of the same population variance, i.e., that the theoretical variance about the regression be the same in all the cases under consideration.

If this condition is met, a pooled estimate of the variance about the several regression lines, $\bar{s}^2$, is calculated as a function of the individual s^2 quantities and their associated degrees of freedom.

There were only two cases in which two digesters could be compared with each other (tests 2 and 6, Table IV), because only in these instances, among a number that were considered, was the condition satisfied. Where a multiple test of equality had to be made Bartlett's test was applied.[‖] Such a test, made on the variances of the 89 digesters to be compared, implied a fantastically high degree of improbability for the hypothesis of equality. Similar tests, confined to individual mills that appeared to have the most consistent data, gave results of comparable improbability.

Such results may be expected when the requirement of stochastic independence among the observations is not met. The principal reason for this effect is the drastically reduced number of degrees of freedom present in the data when there is lack of independence, making the originally assumed number of degrees of freedom, on which the estimate of the variance is based, fictitiously high.

While the variances may have truly varied from mill to mill (because of the possibility of varying measuring procedures), apart from the effect of nonindependence, it could be expected that the variances within mills should be constant. This was not found to be the case. Thus, the evidence for widespread nonindependence was strong.

The problem of unequal variances has been investigated extensively, by W. M. Long (*6*) and P. Meier (*7*), among others.

The approach generally has been to derive an expression for the number of degrees of freedom, $\bar{f}$, associated with $\bar{s}^2$. This expression is usually a function of the individual s^2 quantities and their degrees of freedom, as is $\bar{s}^2$, itself. $\bar{f}$ is a compromise between the theoretical maximum number, $M - 2m$ and a pessimistic minimum of 1, where M is equal to the total number of data and m is the number of regression coefficients being compared.

The consensus of opinion is that more error is introduced in doing this than in hypothecating that the test statistic, b in this case, is a single measurement from a normal population, and testing this hypothesis with regard to various groupings of the individual values of b.

The decision to do this was made, though reluctantly. It had been hoped to use the much more sensitive regression tests. Using these tests, it should have been possible to utilize statistical techniques as a probing finger, searching for obscure effects. With the less sensitive tests the analysis assumed rather the role of a restraining influence, pointing to lack of statistical significance in some cases where the subjective eye would have been inclined to find it.

The enforced restriction of the sensitivity of the tests used is a strong argument in favor of a critical examination of the measuring techniques in use at each mill the establishment of industry-wide standards in area.

It was noted in the section "Analysis of Varian that techniques other than the analysis of variance u were available for the study of directional varia in corrosion rate in individual digesters. In particu it is possible to calculate regression coefficients at e inspection point, based on all the inspections, and perform an analysis of variance on these coefficie (*10*). This procedure has the advantage of utili all the available data, although the question of ho geneity of variances must again be answered. On other hand, the technique which was used is a suf ently good, if somewhat simplified, description of directional variation and has computational econo to recommend it.

There was some question regarding the necessity confining tests concerning classes of steel to within-r groups. This problem was studied by performing t of the equality of means, in certain classes, betw mills. Two such tests were made, in the old-rimm and new-ordinary classifications, and both of th indicated a significant difference between mills. Th tests suggest that some variables, as yet unidentif affect corrosion differences between mills, and jus the within-mill procedure adopted in the analysis.

APPENDIX II—CODE NUMBERS OF DIGESTERS COMPARISONS

Test no.	*Comparison*	*Code no. of digesters*
1	Old-ordinary	43, 46, 48, 50, 52, 55, 5 59, 61
	New-ordinary	49, 53, 60, 62–70
2	Old-ordinary	79
	New-ordinary	74
3	Old-rimmed	75–78
	New-rimmed	72, 73
4	New-ordinary	11, 13, 15–17, 19, 20, 22
	New-rimmed	14, 21, 23
5	Old-rimmed	29, 30, 35, 36
	New-ordinary	24, 25, 27, 28, 37, 38
6	Old-rimmed	90
	New-ordinary	91
7	High-tensile	42, 47, 54
	New-ordinary	49, 53, 60, 62–70
8	A285C	3, 6, 8, 9
	A70	4, 5, 7, 10
9	A285C	24, 27
	A70	25, 28, 37, 38
	A89	29, 30, 35, 36
10	Inconel, 410SS	12, 18
	New-ordinary	11, 13, 15–17, 19, 20, 22
11	Inconel	44, 51, 56
	New-ordinary	49, 53, 60, 62–70
12	347SS	99, 100
	New-ordinary	101, 102
13	Kraft	24, 25, 27–30, 35–38
	Neutral sulphite	31–34
14	Kraft	3–25, 27–30, 35–38, 42–4 46–70, 72–79, 90, 91, 93 102
	Soda	1, 2, 80–86, 92
15	Forced circulation	1–10, 80–86, 92
	Natural circulation	11–25, 27–30, 35–38, 42 44, 46–70, 72–79, 90, 91 93–98
16	Direct heating	1, 2, 11–25, 27–30, 35–38 42–44, 46–70, 72–86, 90 91, 93–102
	Indirect heating	3–10, 92
17	Northeastern mills	1, 2, 80–86, 92
	Southeastern mills	3–10, 42–44, 46–70, 72–79 93–102
	South-central mills	11–25, 27–30, 35–38
	Northwestern mills	90, 91

[‖] See Hald (*4*), p. 291.

The Continuous Preparation and Application of Silica Sols in the Paper Industry

L. L. KLINGER

The development of the continuous preparation of silica sols was begun in 1945 and was carried on by a leading manufacturer of proportioning equipment to a finished and efficient process. The purpose for continuous preparation is threefold: (1) simpler automatic operation, (2) less labor requirement, and (3) more compact equipment requiring a minimum of floor space. Although the process has been extensively investigated and proved in the treatment of mill process water, indications are that it will be of use in certain whitewaters and machine furnishes.

THE successful application of activated silica for the improvement in the coagulation of surface waters, previously reported (*8*), suggested the extension of work in the general field of continuous preparation and in further application to surface water and certain phases of paper machine operation and whitewater recovery. The work and the results obtained are shown herein.

In order to avoid considerable repetition of the previous paper (*8*) suffice it to say that the use of activated silica has progressed rapidly in the paper industry during the last decade.

One of the early proponents of the use of activated silica in the industry was Miller (*13*). In 1939, while investigating with silica sols in water clarification, he found they likewise applied for the retention of clay and filler in the manufacture of paper. He stated, "The subject is too new and complex to attempt to predict to what extent it will meet with practical success. It would offer a fertile and perhaps very productive field for further investigation."

In the last few years, Miller's prediction has become a reality. Morrison (*14*) and MacGonagle (*9*) report that silica sols have been used with success, but have not elucidated on any specific cases. Rudolf and Axe (*16*) found for paperboard mill wastes that alum supplemented with activated silica was 3 to 20 times more effective than alum alone.

Merrill and Bolton (*10*) review the use of activated silica in whitewater coagulation, coagulation of oil waste, and in boiler water treatment. They also theorize on the reaction of the sol, stating that the applications of activated silica depend mainly on the size, charge, and adsorbability of the silica micelle. Controlled aging time controls the size of the micelle. By changing pH or by forming the sol in the presence of ions and molecules which are adsorbed, the change on the colloidal silica particle may be varied.

They say further, "Activated silica can be used alone to coagulate positively charged colloids. It also improves flocculation by alum, copperas, or other positive hydroids of colloidal particles with a net negative charge. This can be accomplished by reaction with the positive charges present on many natural colloids, such as proteins, even though the net charge on the particles is negative. More complete neutralization and dehydration thus result. The activated silica also reacts with alum to form a firm floc which enmeshes, entangles, and absorbs impurities as it settles. The colloidal particles also act as a nucleus to prevent supersaturation. More complete coagulation and removal of suspended and dissolved material thereby are accomplished." The above represents one of the most extensive and inclusive conceptions that has been published.

An interesting article (*2*) has been published on the use of silica by the Downington Paper Manufacturing Co. in the recovery and clarification of solids consisting of fiber, mineral filler, and miscellaneous organic solids found in the usual raw stock for boxboard manufacture. The recovery unit consists of an Accelator employing alum as a coagulant and using activated silica as an adjunct. It is claimed that the sludge is reused in the filler stock. No figures on effluent solids are given.

Clodfelter (*4*) reports that activated silica is efficient on the paper machine wire where ground wood and filler were used in the furnish. He regarded recovery in the Sveen Pedersen saveall more efficient with glue, having found that the voluminous and highly densified floc formed with silica did not retain enough air to float well.

Wheaton and Walker (*19*) have reviewed the American uses of silica sols and have extended that experience in Great Britian. Merrill, Spencer, and Middleton (*11, 17*) have dealt with the gelation of the sol useful in interpreting academically finer points of the preparations. Middleton (*12*) has reviewed treatment in the potable water field as well as on waste water.

Henry (*7*) has dealt with the activity of silica sols as well as investigating sols made with carbon dioxide (*6*). A very recent article by Andrews (*1*), following the work of Henry, deals with the continuous preparation of activated silica with carbon dioxide. Black (*3*) has reviewed the use of activated silica in water treatment. In a discussion of Black's paper, Griffin refers to work that will be dealt with in this paper.

THEORY AND METHODS OF ACTIVATION

Activated silica hydrosol is prepared by the partial or total reaction of the sodium oxide content in sodium silicate. The process involves the reaction of a suitable grade of sodium silicate, such as one having a ratio of 1 part of Na_2O to 3.2 parts SiO_2. A typical analysis is Na_2O, 8.9%; SiO_2, 28.7%; and water 62.4%. The activant to be dealt with in this paper is chlorine, N-Sol C (*15*), wherein the reaction takes place as follows:

L. KLINGER, Project Engineer, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

$$Cl_2 \text{ (gaseous)} + H_2O \rightarrow HCl + HOCl$$

$$Na_2O \cdot SiO_2 + HOCl + HCl \rightarrow {}^{-}SiO_2{}^{-} + NaOCl + NaCl + H_2O$$

Activation or colloidal micelle growth occurs through a release of silica from the sodium silicate, indicated above as activated or colloidal by labeling: $^{-}SiO_2{}^{-}$. The degree of activation is varied and controlled by the starting dilution of the silicate, by detention (aging), by the mol ratio of activant to the sodium silicate, and by the reaction temperature.

The colloidal condition of the $^{-}SiO_2{}^{-}$ is stabilized by secondary dilution with water. After a certain aging time at a certain starting dilution in batch treatments, the dilute colloidal solution is further diluted by approximately 33% more water. From this point the relatively stable sol can be put to process by proportioning pumps, a batch being large enough to last an economic and convenient time until the next is made. In continuous treatment, aging is, for convenience and economic size of equipment, accelerated and is then cut abruptly with considerable dilution to stabilize the sol after which it is immediately used.

One of the additional benefits of the chlorine activated sol is apparent by inspecting the reaction shown. In it the second equation indicates that sodium hypochlorite is a product of the reaction. In other words, the chlorine used as the activant is not lost but is available for sterilization. Ordinary practice has shown that some 5 to 10% is absorbed in the reaction, possibly setting up some side reactions not yet known.

The role of activated silica becomes evident in coagulation reactions where alum or other usually highly positively charged coagulants are used. Excessive positive charges due to the coagulant reacting with negatively charged colloidal color or turbidity in raw waters, or clays and other fillers in white water, can be reduced with the colloidally negative silica sol for more nearly perfect equalization of charges with attendant densification and toughness of the floc formed. Flocs usually form and settle more rapidly. In down flow clarification of raw surface waters, the benefit is self evident. In clarification of whitewater by settling the same benefits hold true. On the paper machine a faster forming and more voluminous floc aids in filler retention.

The counter role of negatively charged silica exists if coagulation of impurities occurs when natural positive charges are present in the medium. In such cases,

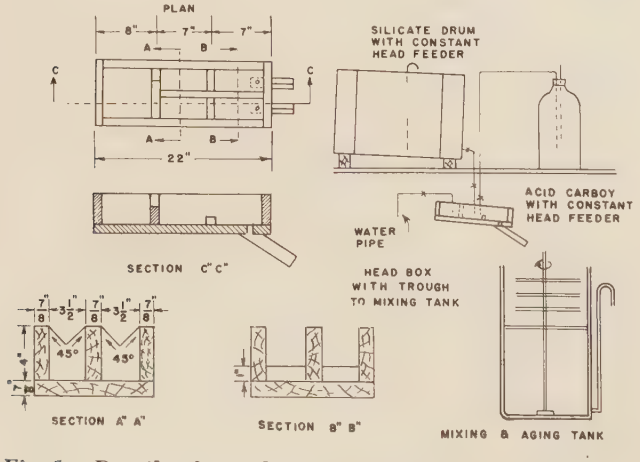


Fig. 1. Details of simple continuous feeder, headbox design, and scheme of constant feed to mixing tank

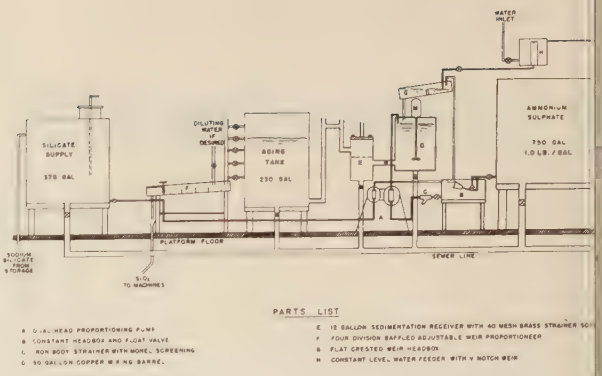


Fig. 2. Continuous feeder employed on white water t ment at the Biron Division of Consolidated Water P & Paper Co.

there has been evidence that silica alone can be use a coagulant, if these charges are not too intense.

In general, the types of sols in use in the pape dustry follow two distinct patterns of chemical prep tion, viz.; alkalinity reduction or the use of alk reactants. In the former, as shown in the reaction chlorine, the Na_2O content of the sodium silicate i duced. An extensive number of sols have been inv gated (*15*), but sulphuric acid, chlorine, and com acid salts are generally used. In the latter, efforts l been confined chiefly to ammonium sulphate, soc bicarbonate, and carbon dioxide. The reactions o latter are speculated to form slightly ionized, hea hydrated gelatinous salts (*3*).

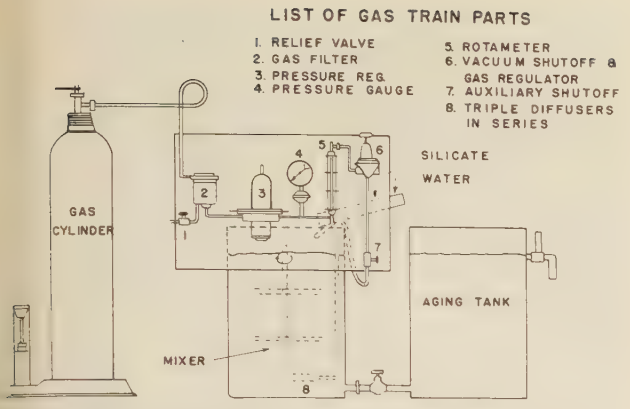
DEVELOPMENTS IN CONTINUOUS PREPARATI

The initial application of silica sols in the w purification plant at the Wisconsin Rapids Divisi covered by the previously reported paper (*8*). In i first trials were made with a small batch setup w required a reasonably high frequency of prepar The interest in the use of activated silica at this l tion extended to other applications on process whitewater at the various divisions. In order to these trials, the concept of continuous applica naturally followed. If it were possible to move mo amounts of equipment to different locations wit difficulty, these trials could be carried on without serious capital expenditure.

Therefore, in March, 1945, a simple continuous fe was built, shown in Fig. 1. Following the essentia a batch process, in which silica sol was activated at 1 SiO_2 concentration, and diluted to 1% after aging, continuous feed equipment was sized large enoug operate for a dosage of better than 3 p.p.m. It sisted of a 30-gal. tank divided into two sections, for mixing, and one for aging. The top one third of tank had paddles for mixing the sodium silicate activating agent. A segmental plate divided the c partments. In it, were two holes, which were port the aging zone.

Figure 1 also shows a cut of a simple headbox in w the water was metered and split into two portions, portion being used for diluting concentrated sili fed from a constant head and the other portion for d ing the liquid reactant also fed from a constant head

This arrangement, although crude, indicated tively that silica sols could be prepared continuo with liquid reactants. A further extension of cont



g. 3. Experimental continuous preparation with gaseous reactants

is feeding with liquid reactants was designed for the ron Division and was used there for a period of two ears on whitewater treatment. It is indicated in Fig. 2. nce these developments, Infilco, Inc. and Omega achine Co. have designed some packaged units which ve been marketed to a limited extent, but are finitely improvements over home built systems.

The concept of feeding with gaseous activating agents as dealt with shortly after the initial trials with liquid tivating agents. It appeared reasonable that proortioning of gas, well recognized in the industry for ears, should offer the fineness of control for continuous uipment which could be used day in and day out ithout a great deal of control and observation by erating personnel.

Figure 3 shows the method used for applying a aseous reagent. The gas was filtered, reduced to a onstant pressure, and was metered by a rotameter rough a vacuum shut-off valve. From this valve it as introduced through alundum diffusers. At the art of applying gaseous reagents, the one tank was sed, but most of the succeeding work was done with a 0-gal. aging tank in series with the 30-gal. tank that ad previously been used for both mixing and aging. ith this arrangement, the segmental plate shown in ig. 1 was removed and the diffusers were placed at the ottom of the tank and the entire tank was used as a ixing tank.

Various trials, using chlorine, were made with the ove described gaseous equipment during 1945. This perimental setup proved definitely that it was feaible to use gas feeding equipment for activating silica, ut that the method of metering had to be more precise an what could be obtained with the home built uipment, which, by necessity, had come from the reaiming department in order to hasten this work during e critical material shortage of World War II. At is time an accurate proportioning pump for handling d proportioning concentrated sodium silicate was so obtained.

To further improve the gas feeding process, a gas ed chlorinator was obtained from Wallace & Tiernan, c. in November, 1945. After this feeder had been put to operation, a very definite improvement in conolling the process was apparent. By this time, repsentatives of Wallace & Tiernan had become conderably interested in the continuous feed development d began working on the development with Consolidated. Although the use of the orifice gas feeder was a considerable improvement, it was recognized that the process was far from a proved and dependable one. One of the chief difficulties occurring was overgassing of chlorine which created quite some consternation with operators handling the equipment.

In this interim period, the uses of other more absorbent gases were tried. Carbon dioxide, tried for 2 months in 1946, produced a reasonably active sol. Its use is indicated where recarbonation is used or where its special characteristics make it attractive. Sulphur dioxide was used for 5 months in 1946 on a 24-hr. around the clock basis in the Wisconsin Rapids filtration plant. Control with this gas was excellent as it was highly absorptive in the alkaline sodium silicate medium. Its use is indicated where dechlorination is necessary or where waste SO_2 is available cheaply. From the middle of 1946 through 1947, the continuous preparation of silica was conducted using the Baylis (*15*), or sulphuric acid process. During the latter trial, an excellent pump for handling small quantities of concentrated acid had been purchased from Proportioneers, Inc. It handled metered flows of acid accurately down to 7 ml. per min. The Baylis method is one of the more standard methods for preparing activated silica. However, handling sulphuric acid is objectionable unless the process is extensive and bulk quantities are used.

INDEPENDENT CONTINUOUS FEED DEVELOPMENT

During the years 1948 through 1951, the research and development staff of Wallace & Tiernan, Inc., fully aware of the advantage of developing a simple operating and compact machine for preparing activated silica, worked diligently on producing a commercially acceptable feeder. The outcome of their work, after realizing that direct chlorine gas injection would not be practicable, was to go to the principle of absorbing the chlorine gas in an aqueous media with their vacuum chlorinator and then introduce this chlorine solution into a chamber wherein sodium silicate was pumped with a proportioning pump and diluted with the chlorinated water flowing to it.

The operation of the feeder, now called the W & T Silactor, involves the metering and control of three interrelated quantities; viz., sodium silicate feed, chlorine flow, and dilution water flow. Formulas are provided in their instruction book (*18*).

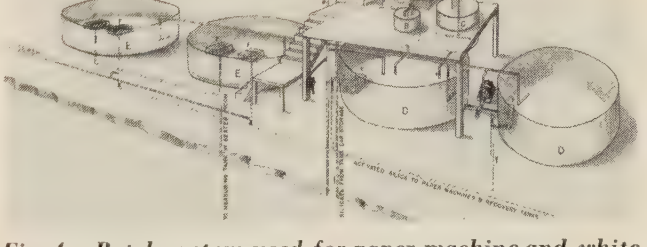


Fig. 4. Batch system used for paper machine and white water treatment at the Wisconsin River Division of Consolidated Water Power & Paper Co.

Batch system parts list: A, 375-gal. silicate supply tank; B, 200-gal. silicate measuring tank; C, 710-gal. activated chemical makeup tank; D, 6400-gal. mixing and storage tanks; E, 5700-gal. storage tanks; F, 14-mesh outlet screens.

The flow of necessary water, silicate, and chlorine are dependent upon the dosage of "SiO_2" to be fed and the quantity of water to be treated. General variations of dosage can be governed by experience only, but the following estimates are indicated as a guide.

1. Most raw waters—average 5 p.p.m., maximum 20 p.p.m., minimum, 1 p.p.m.
2. Industrial waste—5 to 25 p.p.m.

When dosage is based on alum usage:

3. For low turbidity, low temperature water—15 to 40% of usual alum dosage.
4. For high turbidity, or color removal—5 to 15% of usual alum dosage.

INDUSTRIAL USE OF THE SILACTOR

Before complete refinements had been made on the newly developed Silactor, or while it was coming out of experimental development, one of the first three was sent to Consolidated in September, 1951. At the Biron water purification plant the efficiency was evaluated against old tests with homemade continuous feeders. Operating at a dilution of 2% SiO_2 and a reaction percentage of 100%, at a feed rate of 3 p.p.m., it looked sufficiently promising on Wisconsin River water to translate its use for the Fox River at the Appleton Division.

At this latter division, a new water clarification plant of the Infilco upflow design had been completed in October, 1952. To eliminate the need for huge storage of batch "SiO_2" in the new plant, two of the first improved Silactors were selected to do the work of producing the required activated silica at a dosage of 3 to 5 p.p.m. for 12 to 14 m.g.d. A comparison of the size of installation of a batch system in operation at the Wisconsin River Division on white water is shown in Fig. 4 against Figs. 5 and 6 with Silactors at Appleton. The Silactors require a total floor space each of some 17 by 30 in. or a total area of some 7 sq. ft., and can be accommodated in a room of about 50 sq. ft. The batch application at Wisconsin River to produce a comparable amount of sol requires some 1350 sq. ft.

The rear view shown in Fig. 6 shows the essentials of the Silactor. To the left is the vacuum chlorinator. At the upper right is the chlorine solution chamber, and at the lower right is a lucite mixing and aging chamber. This transparent chamber is removable for periodic cleanup as the silica sol in this chamber has a tendency

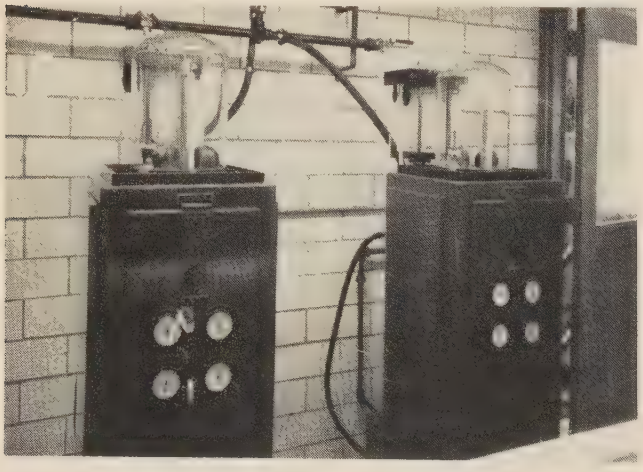


Fig. 5. W & T Silactors in new water clarification plant at the Appleton Division of Consolidated Water Power & Paper Co.

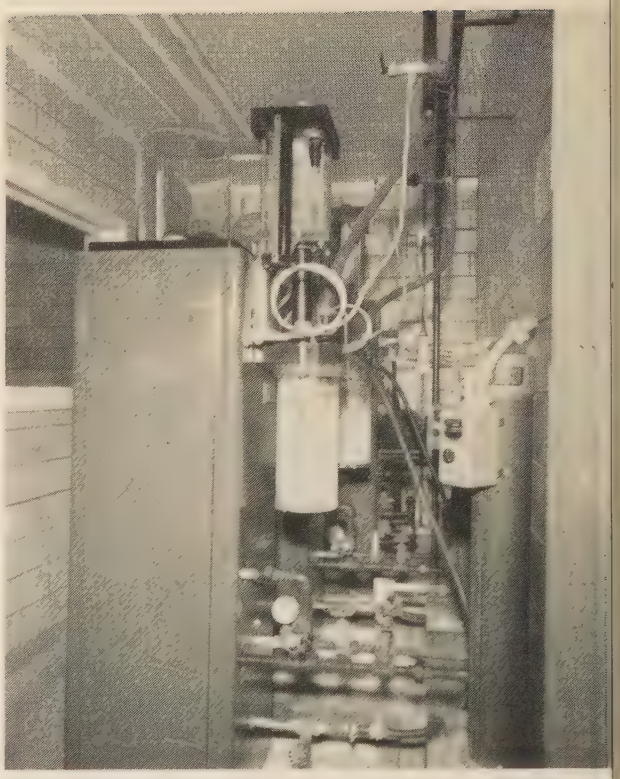


Fig. 6. Rear view of the W & T Silactors showing essentials

to form a light gel on the walls of the chamber, it be the only portion of the Silactor which comes in con with the concentrated silica sol. Sodium silicat purchased in tank car loads. The undiluted silicat metered to the Silactors by means of accurate pro tioning pumps from bulk storage.

Operation of the two Silactors at Appleton has l routine. No extra help is needed to prepare activa silica as might be the case in a batch operation. regulator operator watches the Silactors and runs necessary control tests to determine the activity of sol.

The "gel induction" time is the primary routine for determining the activity of the sol for a cert application. In it a sample from the mixing and re tion chamber is collected in a small beaker. This sa ple is taken by removing a small plug in the cham from which a small stream of the activated sol will fl By checking with a watch the length of time in wh the sample just barely begins to set up or gel, as de mined by slightly tilting the beaker, is the "gel ind tion" test. This test, on various applications, been found at SiO_2 concentrations from 1.5 to 3.0% vary from 5 to 30 min. It is likewise dependent u the percentage of neutralization. No standard can determined, as it is a matter of interpretation fo particular application.

Figure 7 shows a set of curves useful in checkin Silactor performance. In it, with the concentration SiO_2 known, a 10-ml. sample taken from the react and aging chamber of the Silactor can be tested means of the ordinary thiosulphate test. By use the graph, available chlorine, percentage reaction, a alkalinity reduction can be determined. This alka ity test is practically impossible to run with ordin acid titrations because of the bleaching of indicators

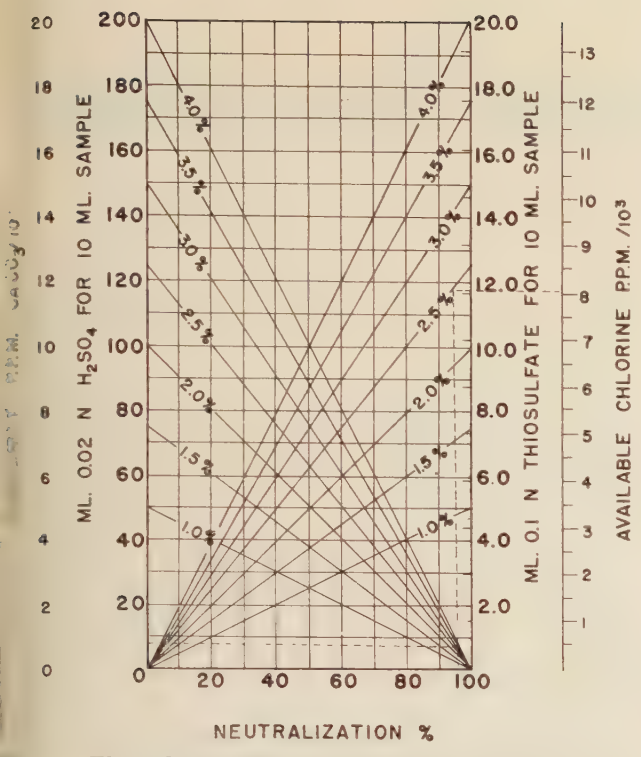


Fig. 7. The relation between alkalinity and neutralization of silica at various concentrations and relation between alkalinity and available chlorine for the reaction of N-Sol C

ne chlorine. The example shown by dotted lines indicates that at a reaction of 2.5% for a thiosulphate test of 12.1, the per cent neutralization is 92, the alkalinity is 800, and the available chlorine is 8100 p.p.m. in the solution.

APPLICATION OF SILICA SOLS IN THE PAPER INDUSTRY

A number of applications have been inferred during the discourse of this paper. To go into detail on the various applications investigated would involve another paper; therefore, they will be dealt with only briefly.

Process Water Purification. Activated silica is being used at two mills of Consolidated on the Wisconsin River and one on the Fox. It is anticipated that the continuous feed of silica will eventually be used at all these divisions.

White Water Control. Silica is now being used at the Wisconsin River Division at Whiting. A total feed of 0 p.p.m. is split between the paper machine and the Dorr white water clarifiers. Better retention is had on the wire and white water solids are very low, averaging considerably less than 1 lb. per 1000 gal.

Sveen Pedersen Savealls. Work to date at Biron and Wisconsin Rapids has not proved very satisfactory. A good floc is formed, but it does not have the tendency to float, defeating the purpose in flotation savealls. These mills previously used silica as at the Wisconsin River Division before the installation of the flotation savealls. This confirms the conclusion of Clodfelter (*4*), although Griffin (*5*) reports to the contrary on an eastern trial with the following data.

In the above test runs glue was used for 20 days and SiO_2^- for 19 days. Considering the extreme versatility of activated silica, no doubt, studies in pH variations to furnishes and usage of some of the less familiar sols,

	Glue	*SiO_2*
Influent solids, lb./1000 gal.	3.40	4.20
Effluent solids	0.47	0.28
Efficiency, %	85–87	92–97

such as the phosphate sols, or other less known types may lead to better results on flotation work.

Results with Special Fillers. At one division, the addition of $0.35 of silica per ton reduced a titanium filler loss by $0.65 to $0.75 and reduced the solids going to the river by 20%. This division now has a flotation saveall and the trials have not been repeated subsequent to its installation.

Results on Board Furnish. Experiments have indicated that a feed of 8 to 12 p.p.m. on a board furnish will increase fines and filler pickup in the sheet. When sizes, such as Bitusize are used, 20 to 30% better retention can be expected.

Iron Removal. In removing iron from well waters by coagulation and sedimentation, experimental development has indicated the possibility of coagulating with modest amounts of alum on the acid side with a couple of parts of SiO_2^-. This represents an entirely new concept in iron removal wherein the general practice is coagulation in the presence of lime on the highly alkaline side.

Paper Mill Wastes. The use of activated silica, in coagulation of mill wastes, which can be considered an extension of white water treatment, has been indicated in all cases on book as well as board mill wastes.

The continuous feed of activated silica with liquid or gaseous activating agents is now readily possible by the purchase of available commercial equipment. The size and maneuverability of this equipment make it practicable to study in a mill any number of applications in process water, white water, and waste water treatment.

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Case History of an 850 P.s.i.g. Topping Turbine Installation

H. R. EMERY and P. L. NELSON

Steam and power generating equipment in many of the older pulp and paper mills in the country is obsolete, inefficient, and approaching the end of its useful life. The modernization of a typical old steam power plant at the Deferiet mill of the St. Regis Paper Co. is discussed. The case history covers: (1) the original steam plant and previous changes made in it, (2) engineering studies preceding the actual installation, (3) equipment installed in the new steam power plant, (4) preliminary operating problems encountered, and (5) present-day operating costs of the new power plant.

THE Deferiet mill is the original mill of the St. Regis Paper Co. This mill, completed in 1901, was described in the newspapers of that day as a "gigantic manufacturing institution." Installed equipment included four paper machines with widths varying from 90 to 145 in. Machine speeds running up to 350 f.p.m. were obtained, and were considered very high. The boiler house contained twenty 100-hp. Watertown Iron Works boilers grouped in batteries of five and hand fired. Four Watertown Engine Co. 300-hp. reciprocating steam engines were installed in the engine room, their power being transmitted by belt and lineshaft to the machines. Three 500-light generating units were installed for electric power, these being driven through a rope drive either by steam engine or water power.

PREVIOUS CHANGES IN STEAM POWER PLANT

The mill started up and operated on the above-listed steam and power equipment until 1913 when two 610-hp., 150 p.s.i.g., Sterling-type, stoker-fired boilers were installed in battery. In 1915 nos. 3 and 4 boilers were installed, followed by nos. 5 and 6 boilers in 1921; all the same size and type of Sterling boiler. Of the 20 original Watertown Iron Works boilers installed in the mill, two are still in operation as bark, sawdust, and trash burners in the small boiler house in the yard. The others were junked or scattered over a considerable portion of the northern New York area for various types of service.

During the years 1924 to 1927 the reciprocating drives on the four paper machines were replaced with individual turbine drives. Numbers 3, 4, 5, and 6 boilers were redesigned for pulverized coal firing, size F Aero pulverizers were installed on each boiler, and superheaters giving 80°F. of superheat were added. Numbers 1 and 2 boilers were relegated to an emergency standby basis.

In 1925 the Central New York Power Co. installed a 5000-kw. condensing turbine-generator in a powerhouse built on the mill premises adjacent to the boiler house. This was operated by the utilities during times of the year when low river flow limited the power output of their hydroelectric plants. Steam to ope this turbine-generator unit was purchased from St. Regis Paper Co.

No further changes in the steam and power syst were considered until 1936 when, due to the age of operating boilers, it became apparent that new st generating equipment would soon be required.

ENGINEERING STUDIES PREVIOUS TO 1940

In the years between 1936 and 1939, steam and po surveys were made by several engineering conce Four basic recommendations of major surveys for installation of new steam and power generating eq ment are tabulated in Table I.

Although the results of these studies were prese to the management, no action on purchasing new bo could be taken. One recommendation made as a re of these studies was to purchase the 5000-kw. conden turbine-generator from the Central New York Po Co. This recommendation was followed, and the was purchased by the St. Regis Paper Co. in 1936.

In 1939 additional surveys of the steam and po systems resulted in three more basic recommendati The results of these additional studies are tabulate Table II.

This second set of studies was advanced for the sideration of management, and again no action be taken on the power expansion program. How the results of the various surveys have been liste outline form to show that the management of the was continually exposed to the thinking of the cons ing engineers, and that the recommendation of the sulting engineers was toward continued higher opera pressures for industrial steam power plants.

In 1940 a fifth paper machine was installed at mill, and went into service in August of that year.

STUDIES IMMEDIATELY PRECEDING THE INSTALLATION

In 1940 the consulting engineers from Chas. T. M Inc. made their first engineering survey at the Defe mill. Their original recommendations, based upon steam and power requirements of the mill with five paper machines were as follows:

1. Install two 70,000 lb. per hr. pulverized coal-fired boile operate at 600 p.s.i.g., 750°F.
2. Install one 3000-kw. noncondensing turbine-generator to take steam at 600 p.s.i.g., 750°F. at the throttle exhaust at 150 p.s.i.g. to the pulp and paper mill and t existing 5000 kw. condensing unit.
3. Remove the existing nos. 1, 2, 3, and 4 Sterling boile make room for the two new boilers.
4. Retain the existing nos. 5 and 6 boilers in service as e gency standby equipment.

The investigated investment required was $389 resulting in a gross yearly saving of $79,000 (20.3%

H. R. EMERY, Power Engineer, St. Regis Paper Co., Deferiet, N. Y., and P. L. NELSON, Consulting Power Plant Engineer, Chas. T. Main, Inc., Boston, Mass.

Table I. Summary of Surveys Made in 1936

Survey No.	Recommended boiler	Recommended turbine-generator	Estimated investment	Gross yearly savings	Remarks
1	One 100,000 lb./hr., 500 p.s.i.g., 750°F.	One 3000, kw. noncondensing	$389,000	$126,000 (32.4%)	Includes electrified paper machine drives
2	One 100,000 lb./hr., 600 p.s.i.g., 850°F.	One 3500-kw. noncondensing	$436,000	$137,000 (31.4%)	Includes electrified paper machine drives
3	One 100,000 lb./hr., 900 p.s.i.g., 900°F.	One 4000-kw. noncondensing	$501,000	$158,000 (31.6%)	Includes electrified paper machine drives
4	One 100,000 lb./hr., 1400 p.s.i.g., 900°F.	One 5000-kw. noncondensing	$560,000	$173,000 (30.9%)	Includes electrified paper machine drives

The above studies were based upon: (a) delivered cost of coal = $4.60 per ton; (b) average cost of purchased electric power = 0.6¢/kw.-hr.; (c) number of paper machines at the mill = 4.

Again economic conditions apparently stopped the management from taking the proposed steps to purchase the new power equipment. The advent of World War II stopped any further moves in this direction for the next 4 years. The State Department of Labor, after proper hydrostatic tests, allowed the six existing Sterling boilers to be operated at design pressure through the war years with the provision that steps should be taken to replace them as soon as materials were again became available.

In 1944 Westinghouse Electric Corp. made an independent survey of the steam and power needs of the mill, and came up with recommendations that followed very closely those made by Chas. T. Main, Inc. in 1940, with the exception that the Westinghouse recommendations included their own underfeed stokers, turbines, and generators. Comparing sizes of equipment, estimated investment cost, and estimated yearly savings in operating costs, Chas. T. Main, Inc.'s 1940 report and Westinghouse's 1944 report indicated that each had arrived at the same conclusion. Recommended sizes of equipment were identical, and estimated annual savings over presently installed equipment varied less than 1%.

Plans were made in 1944 for increased paper production at the mill. Installation of the no. 6 paper machine was authorized, and the possibility of a seventh machine in the future was considered. Plans also included changed types of paper such as "on the machine coated papers" along with additional chemical and mechanical pulping facilities. Since any study of mill steam and power requirements is no more accurate than the pulp and paper tonnage figures used in making the study, it was necessary to revise the previous power surveys in order to meet the power requirements of the proposed increase in mill output. Consequently Chas. T. Main, Inc. was retained in 1944 to revise their 1940 report to take into account the increase in steam and power requirements. This final report was based upon the following production figures.

Paper production (seven machines)	306 tons per day
Groundwood pulp production	150 tons per day
Sulphite pulp production	100 tons per day
Bleach production	100 tons per day

From these production figures the average steam and power requirements were estimated. The estimated power requirements are tabulated in Table III, and the estimated process steam requirements are tabulated in Table IV.

Table III. Estimated Electric Power Requirements—Deferiet Mill

Average production, tons per day	Material	Per unit electric energy, kw.-hr. per ton	Total electric energy, kw.-hr. per day
306	Paper	670	205,000
150	Groundwood pulp	1400	210,000
100	Sulphite pulp	170	17,000
100	Bleach	120	12,000
			444,000

Note: 444,000 kw.-hr./day = 18,500 kw.-hr./hr. average for 24 hr.

Using these estimated quantities of steam and power, several sizes of equipment and combinations of the sizes were considered. The final choice was made from the four possible schemes of development outlined in Table V.

Scheme no. 4 consisting of two 100,000-lb. per hr. boilers at 800 p.s.i.g., 825°F. and one 6000-kw. noncondensing turbine-generator was the recommendation made by Chas. T. Main, Inc. to the St. Regis Paper Co. as step 1 of a long range steam and power expansion program. The full recommendation was to complete the expansion in three steps as follows, the last two steps being deferred into the future.

Step 1—to be done as soon as possible.

1. Install two 100,000-lb. per hr. pulverized coal-fired boilers to operate at 850 p.s.i.g., 850°F.
2. Install one 6000-kw. noncondensing turbine-generator unit to take steam at 800 p.s.i.g., 825°F. at the throttle and exhaust at 150 p.s.i.g., to the pulp and paper mill and to the existing 5000-kw. condensing unit.
3. Remove the existing nos. 1, 2, 3, and 4 Sterling boilers to make room for the two new boilers.
4. Retain the existing nos. 5 and 6 boilers in service as emergency standby equipment.

Step 2—to be done when nos. 5 and 6 boilers are condemned.

1. Install a third 100,000-lb. per hr. boiler similar to the first two installed under step 1.

Table II. Summary of Surveys Made in 1939

Survey No.	Recommended boiler	Recommended turbine-generator	Estimated investment	Gross yearly savings	Remarks
1	One 120,000 lb./hr., 900 p.s.i.g., 825°F.	One 5000-kw. double ext. noncondensing	$544,000	$178,000 (32.8%)	New turbine to drive 5000-kw. generator purchased from utilities
2	One 120,000 lb./hr., 900 p.s.i.g., 825°F.	One 7500-kw. noncondensing (topping)	$758,000	$262,000 (34.5%)	Includes electrified paper machine drives
3	One 200,000 lb./hr., 500 p.s.i.g., 660°F.	One 5000-kw. noncondensing (topping)	$726,000	$256,000 (35.3%)	Eliminates purchase of electric power

Table IV. Estimated Average Process Steam Requirements—Deferiet Mill

Average production, tons per day	Material	Average per unit steam usage, lb. steam per ton	Total process steam load, lb. steam per day		
			Average	Summer	Winter
306	Paper	9000	2,754,000	2,400,000	3,000,000
100	Sulphite pulp	6000	600,000	500,000	700,000
100	Bleach	3000	300,000	200,000	400,000
		Daily total	3,654,000	3,100,000	4,100,000
		Hourly average	(152,000 lb./hr.)	(129,000 lb./hr.)	(171,000 lb./hr.)

2. Remove the existing nos. 5 and 6 Sterling boilers to make room for the third 100,000-lb. per hr. unit.

Step 3—to be done if ever justified economically. Based on the economics of future purchased power contracts.

1. Install a fourth 100,000-lb. per hr. boiler similar to the first two installed under step 1.
2. Install two additional 6000-kw. turbine-generators to permit the mill to generate all of their required electric power.

The definite decision to go ahead with step 1 of the recommended program was made early in 1945, and design of the installation commenced at once. A simplified schematic diagram of the modernized steam power plant is shown in Fig. 1. It has not yet been necessary to proceed with step 2 or step 3 of the recommended program.

BASIS FOR RECOMMENDATIONS

In order to present the picture in a readily understandable form, the anticipated steam loads were compared graphically to the recommended boiler capacities. This graph is indicated in Fig. 2 below. The steam load curves in this graph show:

1. The variation in the average steam load during the course of an average year. This curve is labeled "average steam load."
2. The amount the average steam load may be expected to exceed the monthly average on any given day. This curve is labeled "maximum daily average."
3. The amount the average steam load may be expected to fall below the monthly average on any given day. This curve is labeled "minimum daily average."
4. The variation in the instantaneous peak steam load during the course of the year. This curve is labeled "anticipated peak."
5. The variation in the instantaneous minimum steam load during the course of the year. This curve is labeled "anticipated minimum."

Bar graphs representing continuous boiler capacities have been included adjacent to the steam load curves to show that

1. The 200-lb. per hr. total continuous capacity of the two new boilers exceeds the maximum daily average steam load in the Winter by about 14,000 lb. per hr., or roughly 7%.
2. In the Summer months with one of the new boilers at a time off the line for the annual inspection and maintenance period, the entire mill steam load can be carried by the remaining new boiler plus the existing nos. 5 and 6 boilers.

The logic of the selection of the two 100,000-lb. hr. boilers, whose combined capacities exceed the ma mum steam load by a small margin, is evident fr this graph. Also the existing nos. 5 and 6 boilers available either as standby steam capacity for the r boilers or to produce 150-p.s.i.g. steam for use in

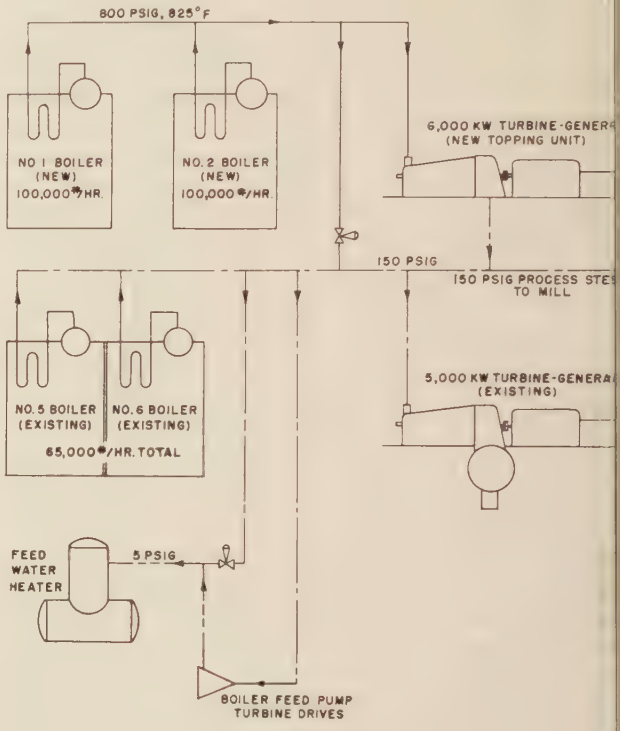

Fig. 1

existing 5000-kw. condensing turbine if condens- power should ever be required in the Winter mont

In selecting the operating pressure and temperat for the new boilers and the kilowatt rating of the n turbine-generator, curves similar to those shown Fig. 3 were used. These curves represent three of many possible combinations of steam pressure, ste temperature, and turbine-generator size that w studied. In general in installations of this type,

Table V. Schemes of Development Considered in 1944—Deferiet Mill

Scheme No.	Boilers	Turbine-generator	Estimated investment	Gross yearly savings
1	Two 100,000 lb./hr., 600 p.s.i.g., 750°F.	One 4000-kw. noncondensing (topping)	$850,000	$120,000 (14.1%)
2	Two 100,000 lb./hr., 600 p.s.i.g., 750°F.	One 5000-kw. noncondensing (topping)	$880,000	$130,000 (14.8%)
3	Two 100,000 lb./hr., 800 p.s.i.g., 750°F.	One 5000-kw. noncondensing (topping)	$1,000,000	$154,000 (15.4%)
4 (recommended)	Two 100,000 lb./hr., 800 p.s.i.g., 825°F.	One 6000-kw. noncondensing (topping)	$1,035,000	$164,000 (15.8%)

he throttle steam pressure and temperature of the opping unit are increased, it is true that

1. For any given steam load, more noncondensing power will e produced and a larger turbine-generator will be required. his is evident from the curves of Fig. 3.
2. The capital investment required will be increased by the eed for higher pressure equipment and a larger turbine-genera-or.
3. The yearly operating costs will be decreased as noncon-ensing steam power replaces purchased power and condensing eam power.

he optimum is, of course, the point where the total f the yearly carrying charges on the required invest-

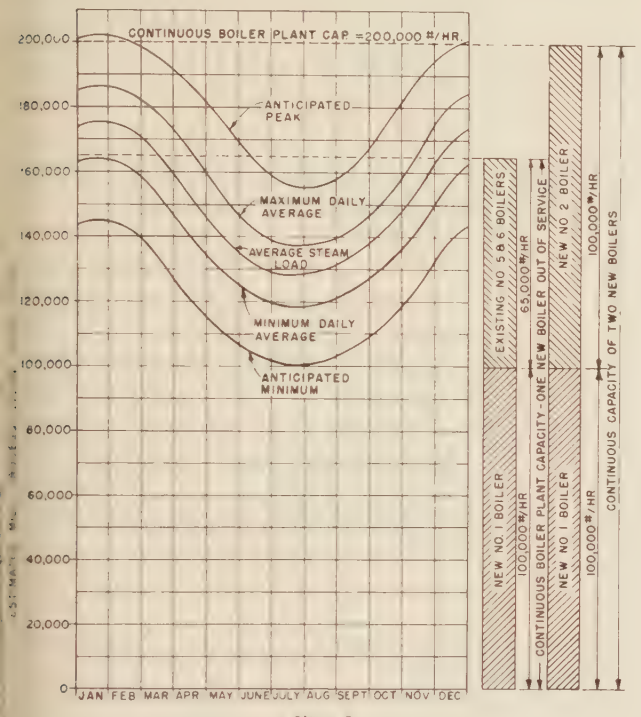

Fig. 2

ment plus the yearly power plant operating costs reaches a minimum. In this particular case this optimum point was reached at steam conditions of 800 p.s.i.g., 825°F. with a 6000-kw. turbine-generator.

PRINCIPAL POWER PLANT EQUIPMENT

Purchasing of equipment and design of the new plant followed immediately the decision to proceed with step 1 of the recommended program. Following is a list of the items of major equipment included in the new steam plant.

Steam Generation

Boilers, 2..... Combustion Engineering, Inc.
Type VU, 100,000-lb. per hr. continuous, 875 p.s.i.g. design pressure, 850°F., 2436 sq. ft. waterwalls, 11,685 sq. ft. boiler surface, 12,655 cu. ft. furnace volume
Air preheaters, 2..... The Air Preheater Corp.
Regenerative
Pulverizers, 4..... Combustion Engineering, Inc.
6930-lb. per hr. Clearfield, Pa., coal, bowl-type, integral exhauster,
Coal burners, 8..... Combustion Engineering, Inc.
4 per boiler, two tiers
Induced draft fans, 2..... The Green Fuel Economizer Co., Inc.
72,300 c.f.m. at 12.75 in. w.g., 370°F., 862 r.p.m.
Forced draft fans, 2..... The Green Fuel Economizer Co., Inc.
39,800 c.f.m. at 7.5 in. w.g., 80°F., 1130 r.p.m.
Magnetic coupling for i.d. fans, 2..... Dynamatic Corp.
Pulverizer and fan motors... Allis-Chalmers Mfg. Co.
Dust collectors, 2..... Western Precipitation Corp.
Soot blowers, 14..... Diamond Power Specialty Corp.
Stationary

Power Generation

Turbine-generator, 1..... Westinghouse Electric Corp.
6000-kw., 0.8 p.f., 3600 r.p.m., 800 p.s.i.g., 825°F., 150 p.s.i.g. exhaust, 2300 v.

Coal and Ash Handling

Coal handling equipment... Link-Belt Co.
50 tons per hr., track hopper, crusher, belt feeder, bucket elevator, transfer belt, bunker belt, tripper
Coal bunker..... Connery Construction Co.
Coal bunker gates, 4..... Stephens-Adamson Mfg. Co.
Automatic coal scales, 4.... Richardson Scale Co.
Ash and dust handling equipment..... United Conveyor Corp.
Steam jet, pneumatic system

Feedwater Equipment

Deaerating heater, 1..... Cochrane Corp.
Tray-type, 310,000 lb./hr.
High-pressure heater, 1..... American Locomotive Co.
Closed, horizontal, U-tube
Boiler feed pumps, 2..... Ingersoll-Rand Co.
500 g.p.m., 2500 ft. discharge

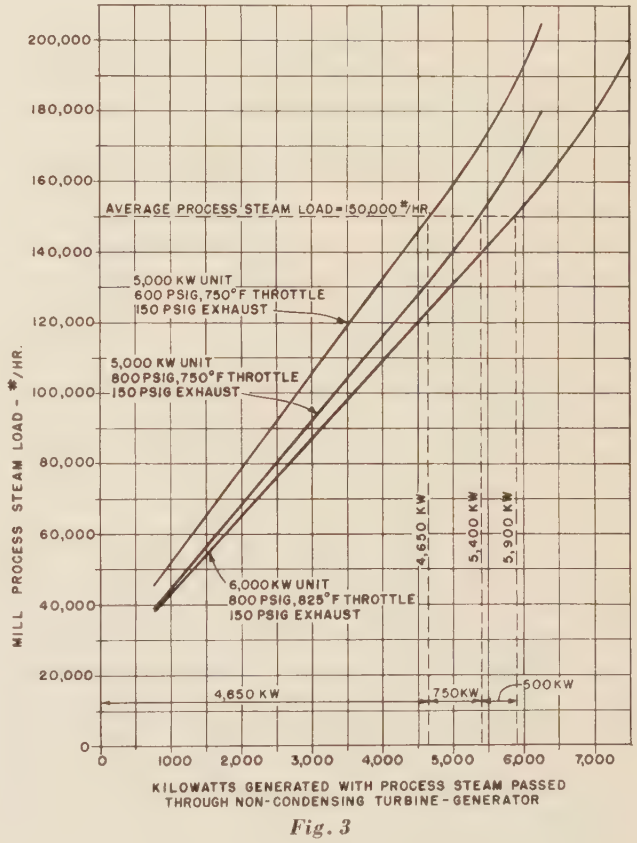

Fig. 3

Boiler feed pump turbines, 2. General Electric Co.
500 hp., 150 p.s.i.g. throttle, 5 p.s.i.g. exhaust
Feedwater regulators, 2..... Copes
Two element
Continuous blowdown system..... Henszey Co.
5 p.s.i.g. flash tank, heat exchanger
Water treatment..... Infilco, Inc.
250 g.p.m., clarifier, pressure filters, sodium zeolite softeners
Chemical feed pumps..... Milton Roy Co.
Water treating consultant (present)..... National Aluminate Corp.

Instruments and Controls

Combustion control..... Hagan Corp.
Recording meters..... Bailey Meter Co.

Miscellaneous Equipment	
Flues and ductwork	Connery Construction Co.
Oil purifier	Bowser, Inc.
Structural steel	American Bridge Co.
Piping	National Valve Co.
Compressors	Pennsylvania Pump & Compressor Co.
Pressure reducing and desuperheating	Swartwout Co.
Building and structure	George A. Fuller Co.
Consulting Engineers	Chas. T. Main, Inc.

PRELIMINARY OPERATING PROBLEMS

Construction of the new steam power plant started in 1945, and operation of the plant started in 1946. For the first two years the regular crew of men who had operated the old 150-p.s.i.g. boilers were apprehensive and unsure of themselves while operating the modern, high-pressure, high-speed equipment. Continued checking gradually uncovered the causes of the initial operating difficulties. The major troubles encountered were as follows:

1. In spite of previous pulverized coal experience in the boiler house, one furnace explosion occurred which required replacement of much of the furnace brickwork.

2. Water treating problems, with both the automatic controls and the types of treatment, were unsettled for some time. Even after the water treatment problems were apparently solved, the operators continued to experience blistering of the front wall section of the new boilers directly over the top two burners. At one time a front wall tube ruptured for a length of about 12 in. due to scale formation blowing most of the water out of the boiler, bulging the furnace walls, drowning out an induced draft fan motor, and perhaps one of the worst effects, increasing the apprehension of the operating personnel.

Mechanical failures in the boiler internals of feed and phosphate lines causing uneven distribution of feedwater and chemicals seem now to have been the major contributors to the blistering of the front wall tubes. Acid cleaning at least once a year was necessary in order to keep the boilers on the line. This practice has been continued although it is now considered that it may be safe to lengthen the period between acid treatment.

Water treatment went through several changes and evolved the following present practice:

River water enters chemical treatment at the clarifier where it is coagulated with alum and sodium aluminate. Much of the color and suspended solids are removed by the coagulation. The clear effluent is then filtered by gravity and softened by sodium cycle zeolite. At this point the water is practically at zero hardness, but for high pressure boiler use it must be further treated to prevent corrosive action on boiler system metals. Flake caustic is added to the roof tank storage to maintain feedwater at a high alkaline condition. Roof tank water flows to the condensate tank, where the mixing of the two waters makes up the feedwater for the boilers. The feedwater is pumped to the deaerator where oxygen is removed, then into the heater tank, at which point sodium sulphite is added, to remove the last traces of oxygen. Nalco 75, a lignin derivative compound which prevents scale formation when used in an alkaline medium, is added with the sodium sulphite solution. The last chemical addition to the water takes place in the steam drums of the boilers where sodium phosphate solution is added to remove the last trace of calcium hardness. Internal inspection for the last two years has indicated that this is successful.

With continued uninterrupted operation, the operating personnel have become confident of themselves of the equipment and now operate through regular erations and unusual conditions with calm assurance

PRESENT-DAY OPERATING COSTS

The total cost of the new steam power plant, the cost of improvements and additions to the electr distribution system not discussed here, was ab $1,900,000. Comparison of savings effected by change are difficult to make due to rapidly chang economic conditions. However, to illustrate the ference between the yearly cost of steam and po using the old equipment available in 1945 and the yea cost using the present equipment, Table VI has b prepared. The cost figures in Table VI are ba upon quantities of steam and electric power used the year June, 1952, to June, 1953, plus the applicat of current labor and fuel rates.

Table VI. Cost of Steam and Power—Comparison of Equipment versus New Equipment

	Total steam, 1000 lb. per yr.	*Total electric energy, 1000 kw.-hr. per yr.*	*Total Cost $ per yr*
1945 Boiler House and Electric Generating Equipment			
Present mill process steam generated with 1945 equipment	1,179,395		$ 877,
Purchased electric power		123,935	1,022,
Total cost of steam and electric power			$1,899,
Present Boiler House and Electric Generating Equipment			
Present mill process steam	1,179,395		
Steam to generate electric power	516,332		
Total steam generated	1,695,727		$1,047,
Electric power total, purchased and generated (exclusive of steam required)		124,680	59
Total cost of steam and electric power			$1,644,
Annual Saving in Total Steam and Power Cost			
$1,899,594 less $1,644,630			$ 254,
Cost of Steam and Power per Ton of Paper			
			$/ton of P
1945 equipment (1,899,594/92,900 tons)			$20.4
Present equipment ($1,644,630/92,900 tons)			17.7
Savings per ton of paper			$ 2.7

The reference literature, "Selection of Steam Pr sures and Temperatures for Paper Mill Power Plan (*1*), has been used to calculate the over-all therm efficiency of the new steam power plant. Using E 4 of the reference literature plus the following d gives a power plant thermal efficiency of 63%.

Steam to main condensers	340,332,000 lb. per
Total boiler steam output	1,695,727,000 lb. per
Per cent of total steam output to condensers	20.1%
Power plant thermal efficiency	63%

During the past year an increase in the purchased el

tric power rate has made the cost of condensing steam power lower than the cost of purchased electric power. As condensing power replaces purchased electric power, the power plant thermal efficiency will, of course, be reduced due to the increased heat loss to the condenser.

Dollars return per year on the new power plant are higher than originally predicted due to the increased cost of purchased electric power since the installation was made. The original savings were based upon a purchased power cost of 0.4 cent per kw.-hr as compared to a present cost of approximately 0.8 cent per kw.-hr. In Table VI, when figuring the total cost of electric power using the old 1945 equipment, it was assumed that 100% of the electric power used was purchased power at an average cost of 0.825 cent per kw.-hr. In figuring the total cost of electric power using the present equipment, it was assumed that as much noncondensing power as possible would be generated to carry the mill electric load.

CONCLUSION

This paper is merely the case history of the modernization of the old steam plant at the Deferiet mill. This type of high-pressure, topping installation can be applied to many old, low-pressure steam plants. As in the case at the St. Regis Paper Co., the savings involved may be considerable.

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Elimination of Odors in a Sulphate Pulp Mill

PIETRO GHISONI

A description of a plant for the elimination of the mercaptans from a sulphate pulp mill is given. The main operations are: (1) condensation of all relief and blow gases with indirect condensers; (2) use of the condensed water as dilution water in a chlorination tower of the bleaching plant; (3) the noncondensable gases are burnt in one boiler together with natural gas; (4) the smoke from the recovery boiler is cooled to the dew point, then oxidated with chlorine and again heated to avoid corrosion in the chimney.

The importance of the manufacture of sulphate pulp is well known, but, it is also a well-known fact that this process, which is continuously developing and improving, presents a very serious inconvenience: the release of sulphurated compounds of unpleasant odor, originating from relief gases, stack gases, and waste waters to the atmosphere.

Obviously, this problem is being attacked in different ways in each mill because of different factors. Among these, the most important ones are the following: situation of the mill, speed and direction of the winds, flow of the river into which the waste waters are directed, and density of the population in the surrounding area. The last factor should not, theoretically, be of any importance since, if the odor is disagreeable for a thousand persons, it will be the same for ten. However, practically, as there is no specific law against products released by the sulphate mills to the atmosphere, the measures taken by the authorities as a result of the people's complaints always correspond to the number of protests received.

Although in the past few years, numerous studies have been made and several articles (*1–5*) published on the elimination of odors, the author believes it may be of interest to report on the studies and the installations made at the Cartiera Vita Mayer & Co. of Milan. The results obtained were very satisfactory, especially in view of the fact that the problem presented special difficulties owing to the adverse location of the mill.

The mill is placed between Cairate and Lonate Ceppino, on the Olona River, an affluent of the Po which flows southward in a narrow valley in the Lombard plain. The difference of level between the bottom of the valley and the surrounding plain is about 140 ft.; and the width of the valley at the bottom is about 500 ft., while at the top it is about 900 ft.

The valley, in its southward direction, becomes less and less deep, until at 5 miles south of the Vita Mayer mill it ends in the plain. The valley passes through a very populated and industrial area, which, within a radius of 6 miles, has more than 180,000 inhabitants.

The paper mill was originally built 90 years ago at the bottom of the valley in order to utilize a small water wheel with about 20 hp. and to use the Olona's waters for the manufacture of paper. Subsequently, the sulphate mill was built as an enlargement of the paper mill.

The pulp mill found itself in an extremely difficult situation as far as the elimination of odors was concerned. The fact that the mill is situated in a narrow valley leads to the formation of heavy masses of air in the valley. These move slowly from north to south, following the course of the river and, 6 miles to the south, flow into the plain, very frequently disturbing the town of Busto Arsizio situated south-southwest of the pulp mill. Furthermore, there is another inconvenience: i.e., the fact that the Olona has a very limited flow, sometimes lower than 200 gal. per sec. Therefore for a long time the waste waters may emit odorous gases since the limited flow of the river does not allow a satisfactory dilution. Furthermore, in the course of 5 miles there are 15 waterfalls for water wheels, which cause the release of mercaptans contained in the water.

In 1939, the pulp mill started production. It was built taking advantage of all the devices known at that time for the minimization of odors to the surroundings. Unfortunately, the results were not satisfactory and, after a few months, especially because of the local situation explained above, people began to complain.

Pietro Ghisoni, Technical Manager, Cartiera Vita Mayer & Co., Milan, Italy.

During the years which followed, the plant was improved. However, results were poor when attempts were made to eliminate the last traces of odorous compounds. This operation became more and more complicated as the mercaptan concentration decreased.

In 1948, it was decided to modernize the plant by introducing the improvements theretofore developed in this field. It was also decided to study thoroughly all sources of odorous compounds as the data published on this matter were highly contradictory (*6–11*). First, an accurate analysis of the waste waters and smokes was performed, obtaining the following results (*12*):

Table I

Digester blow gas, methyl mercaptan, mg./cu. m.		1100
Digester relief gas, mg./cu. m.		7400
Condensate from digester relief gas and digester blow gas, mg./liter		500
Gas from the barometric condenser, mg./cu. m.		480
Stack gases		
	CH_3SH	H_2S
After rotary furnace and boilers, mg./cu. m.	50	...
After disk evaporator, mg./cu. m.	250	...
At the bottom of the stack, mg./cu. m.	100	330
At the top of the stack, mg./cu. m.	50	120

The value of 250 after the disk evaporator becomes 100 at the bottom of the stack since other gases, coming from an oil-fired boiler, are introduced at the bottom of the stack. At the top of the stack there was a fan, which diluted the smoke, adding an equal volume of air. The quantity of hydrogen sulphide after dilution with air passed from 330 to 120; this reduction was probably due to a partial oxidation before the release in the atmosphere.

The volume of smoke from the disk evaporator, with about 7% CO_2, was about 500,000 cu. ft. per pulp ton. This, with a content of 250 mg. per cu. m. gives 9 lb. of mercaptans per pulp ton and 18 lb. of hydrogen sulphide.

In the waste waters, there were about 400 gal. of the condensate from the digester blow and from the relief gas, having a concentration of 500 mg. per liter. A there were 5,000 gal. of evaporator condensates, hav a concentration of 80 mg. per liter in the waste wat In total, there were 4 lb. of mercaptans per pulp to the river.

DIGESTER RELIEF AND BLOW GAS

Today, the cooking plant operates as shown in Fig The relief gases from the digesters pass to the conden Taking into consideration that these condensers w half for the continuous cooking and half for the continuous cooking, it can be seen that the relie discontinuous cooking has a surface of 700 sq. ft. pulp ton while the continuous cooking has 700 sq for condensing both relief and blow gases.

The noncondensed gases enter the hydraulic saf valve, which will be described later, by means of fan having a capacity of 900 c.f.m. and a pressur 180 mm. of water. During the blow, the gases leased by diffusers pass through the cyclone and ar at the condenser.

The condensation surface for the blow is about 1 sq. ft. per pulp ton.

The noncondensed gases are forced to the hydra safety valve by means of the fan having a capacit 2400 c.f.m. and a pressure of 170 mm. of water. the fan suction there is a hydraulic valve from wh the fan takes air from the outside when the diffu system does not produce gas.

The hydraulic safety valve is shown in Fig. 2.

The noncondensed gases bubble in a vessel contain water, passing through a double cone. The cove the vessel is kept closed by means of a water ring wh is maintained at constant level with a continuous toward the interior of the vessel. On the lower pa the wall of the vessel there are three valves at diff levels connected with a siphon tube in order to un continuously the surplus water, keeping the level stant. The movable cover of this vessel has a big fa blinded with a disk of waterproof paper which break in the case of an explosion due to a backfire.

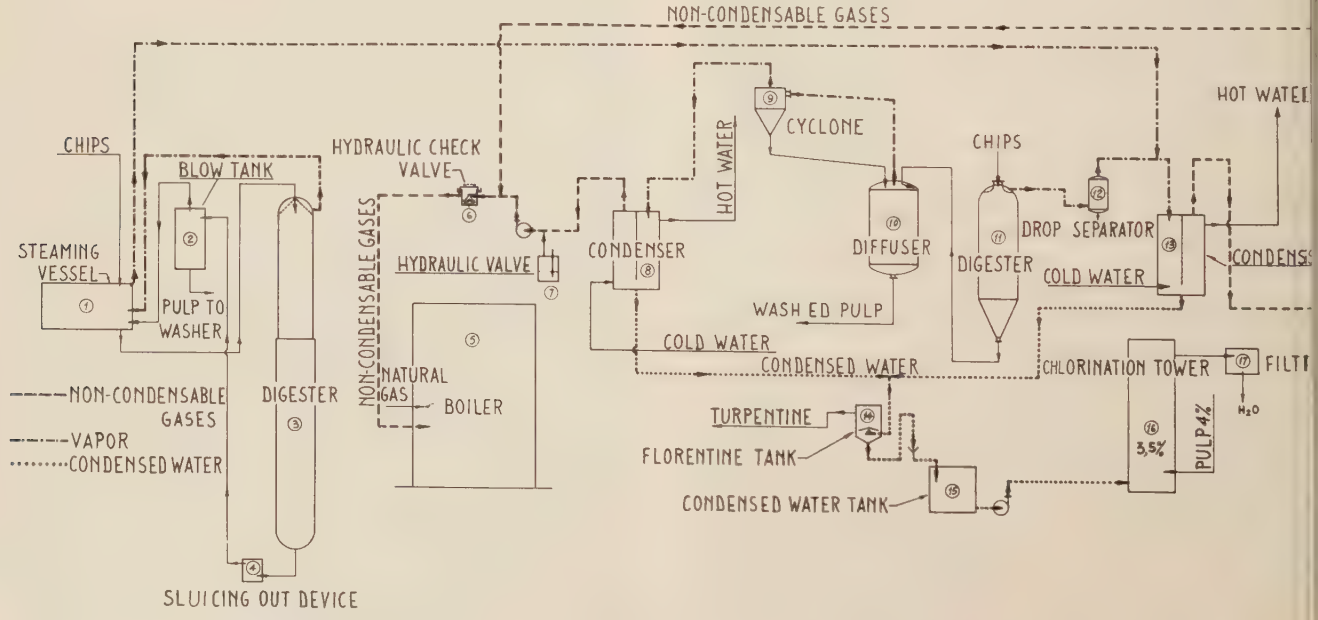

Fig. 1. Schematic plan of alkaline pulping and odor elimination systems

An outlet tube in the higher part of the side wall rings the noncondensable gases to the boiler (see Fig.) where natural gas is used as fuel. The tube enters t the lowest part of the furnace. This is to make sure hat the noncondensable gases cross the area where

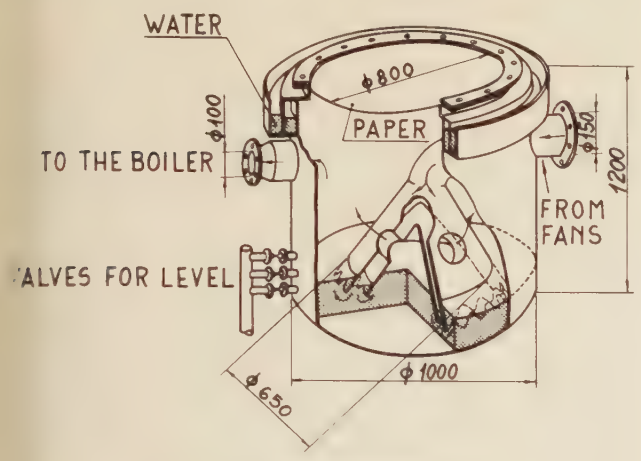

Fig. 2. Hydraulic check valve

here is a high turbulence due to the combustion of atural gas, thus assuring the complete combustion of he sulphur compounds.

In the tube between the boiler and the hydraulic alve, and in the tube between the hydraulic valve and he fan, there are the tubes with flanges blinded with eets of waterproof paper. This is so arranged that n case of an explosion due to faulty operations of the afety valve, the paper may break without danger to ersonnel and the plant.

With this installation it was possible to destroy completely all mercaptans and hydrogen sulphide coming rom relief and blow of pulp cooking. This method is ery efficient, but it is possible to put it into operation nly by making use of all the above-mentioned devices o avoid explosions, or in case of explosions, to have no amage.

To avoid explosions, the velocity of the gases entering be boiler through the tube is 15 ft. per sec. as the speed f explosion of a mixture air-mercaptans has been etermined to be as shown in the following table:

Table II

Gas in the mixture gas-air, %	*Velocity, ft. per sec.*
18.9	1.8
22.8	1.5
23.1	1.3
23.7	1.2
25.5	0.6
25.7	0.5

For comparison, are the following figures of maximum locities:

CO.....1 ft. per. sec.
Natural gas.....0.9 ft. per. sec.
Manufactured gas.....1.9 ft. per. sec.

In order to be sure that the velocity is never lower an 2.5 ft. per sec., a hydraulic valve was installed. hrough it the air which is necessary to keep the required velocity when the quantity of gases from condenser is insufficient is introduced. If for any reason the velocity of gases in the tubes is lower than 2.5 ft. per sec., the hydraulic safety valve does not allow the propagation of the explosion in the part of the plant behind the valve.

During the last 2 years the plant worked perfectly. The only explosions occurred when the electric power suddenly broke down and as a consequence, the flow in the tubes entering the boiler stopped. In these cases the paper on the cover of the valve and on the tee tubes of the piping between the valve and the boiler, broke.

Several analyses made on the gases leaving the boiler gave always negative results in the determination of mercaptans.

CONDENSATE FROM DIGESTER BLOW GAS AND DIGESTER RELIEF GAS

The condensates from the condenser pass into the Florentine vessel in which turpentine is separated. The separated water passes to a tank and, by means of a pump, is sent to the first chlorination tower of the bleaching plant. The consistency of the pulp entering the chlorination tower is kept at about 4% so that the dilution with odorous waters will give a consistency of about 3.5%. All compounds contained in the odorous waters are completely oxidated during the chlorination of the pulp and, therefore, there are no traces of mercaptans in the condensate after this treatment. The consumption of chlorine used for the chlorination of pulp is not substantially increased.

SMOKE FROM COMBUSTION OF BLACK LIQUOR

Black liquor obtained through washing in diffusers (in the case of discontinuous cooking of pulp) and partly through washing in vacuum filters (in the case of continuous cooking of pulp) is collected in a tank (see Fig. 3). From here it is pumped to the oxidation tower to which air is introduced by means of a fan. The mixture of air and black liquor passes to a tank, on the top of which there are four foam breakers to separate

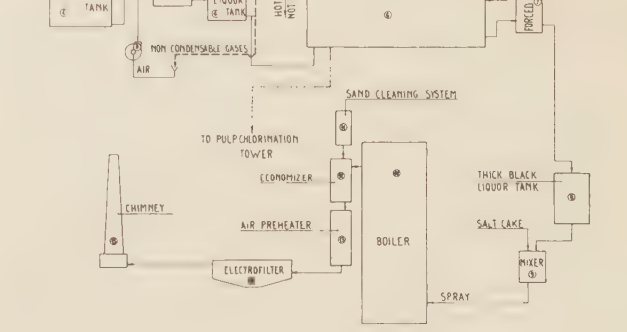

Fig. 3. Black liquor recovery

the black liquor from the air. The black liquor is then evaporated in a six-effect evaporator, the first effect of which has forced circulation. The concentrated black liquor is collected in a tank. From here it passes to the sulphate mixer and hence through a pump to the boiler

nozzle. The boiler is of B. & W. type, with vertical tubes. Smoke leaving from the boiler passes through an economizer and an air preheater and then, by means of a fan, passes to the electro-filter and hence to the chimney.

The recovery was made in this manner because, as is observed from the above analyses, it appears that contact evaporation (disk evaporator or cyclone) enriches the smoke with mercaptans. However, it is possible to obtain a good quantity of steam (5.4 lb. of steam at 12 atmospheres per pulp lb. with 25 TAPPI permanganate number) since the black liquor at the feeding nozzle of the boiler has total solids of 68%.

The condensate from the multiple-effect evaporator is sent to the tank (Fig. 1) together with digester blow and relief gases condensate as it contains still small quantities of mercaptans.

In this connection it was observed that, in order to obtain evaporator condensates without any odor, the degree of oxidation of sulphides in black liquor feeding the evaporator must reach at least 90%. It is possible to reach this degree of oxidation only if the oxidation plant works with a reduced capacity. This is the reason why it was decided to enlarge the oxidation plant. The water from the barometric condenser has no appreciable odor and for the time being is discharged into the river without any treatment. The recovery of this water, to be employed as hot water, is now under study. It was believed that the smoke going out from the boiler through the electro-filter still contained small

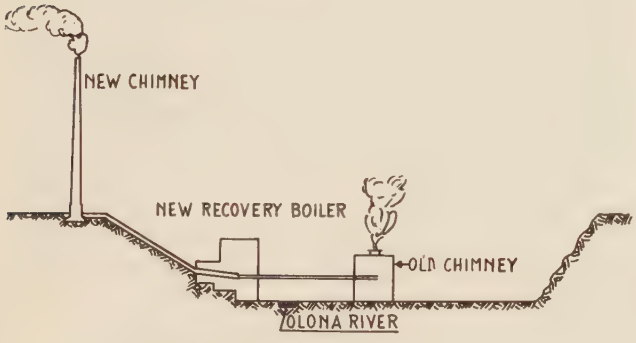

Fig. 4. The valley's cross section

quantities of mercaptans. For this reason a new chimney (see Fig. 4) has been built at the higher part of the valley to release the smoke in a much windier area than the old chimney which opened into the center of the valley at about one half of its depth. It had been noted that there was a normal wind with very low speed (about 1 ft. per sec.) in the valley. Tests taken on the top of the chimney showed average speeds of about 3 ft. per sec. The height necessary for the chimney built at the higher part of the valley was calculated on the basis of the following hypotheses: speed of wind: 10 ft. per sec. (the average varies between 8 and 12) (*12*); mercaptans in the smokes: 100 mg. per cu. m.

Making use of the Sutton formulas (*13*) with an average condition of turbulence and with the coefficients given by Sutton, to obtain the dilution of smoke from the outlet of the chimney to the ground level, assuming a threshold of 1 mg. per cu. m. of methyl mercaptan, taking a safety coefficient of 10 (i.e., placing the odorability threshold at 0.1 mg. cu. m.) it was found that the height necessary for chimney was 180 ft.

The chimney was built 260 ft. high. As the valley 140 ft. deep, it follows that the smoke passes out 40 above the bottom of the valley, while in the old p smoke went out only 70 ft. above the bottom of valley.

The natural dilution through winds has been te from an airplane. In more than 10 tests mad normal periods, the concentration of mercaptans hi than the odorability threshold did not exist more t 2 or 3 miles distant from the chimney laterally, more than 500 ft. above the plain, nor within 17 from the floor of the plain. Furthermore, a strange occurrence has been noted: the odor of smoke cloud is much worse 1 or 2 miles away from chimney than it is at a shorter distance which is diffi to explain. It is possible that in high concentratio smoke, i.e., nearer to the outlet of the chimney, t were other substances partly masking the odo mercaptans. In fact, near the chimney, instead of odor of mercaptans there is a sharp indefinable o Unfortunately the wind is not regular, and as a sequence, although in normal conditions no odo detected in the surroundings, there are days in w there is the characteristic odor of mercaptans in areas south-southwest of the mill. This happen the presence of very weak winds, during the forma at steady masses of air, or during the period of inver of temperature.

No complaint has ever been raised by the inhabit of the area north of the mill. The explanation of fact is very simple. Taking the average of winds years compiled at the Observatory of Venegono, 3 n north of the mill with the anemometers at abou same height as the outlet of the chimney, it has observed that winds vary very regularly during day. During hot hours there are fairly speedy s winds which produce a noticeable turbulent flow to the ground, so that the smoke leaving the chimney be diluted below the odorability threshold be descending to the ground level. On the contrary the north winds coincide with periods of stabilit inversion of temperature, dispersion practically not exist and smoke arrives at southern towns ev miles distant without undergoing a noticeable dilut

Furthermore, through periodical analyses, it been observed that it is preferable to maintain the percentage at about 14% instead of 16% by introdu a slight excess of air into the combustion chambe to have less odor.

Another interesting point, obtained by an obse who records the presence of odors in Busto Arsizi that during 1-year observation, odors are dete most frequently on Monday. This might be expla by the fact that the pulp mill is shut down each w from 6 a.m. on Sunday till 6 a.m. on Monday, therefore the black ash bed in the combustion fur is not as well formed on Monday as it is in the o days. Therefore, on Monday the combustion of volatile substances is less complete.

During February, March, and April, 1953, a tot 15 hours of odor per month has been recorded. figure represents less than 10% of the figure usu

observed 5 years ago south of the mill, and it must be emphasized that pulp production has doubled in the meantime.

At the beginning of this project, when the old plant with a rotary furnace was still in operation, an attempt was made to introduce chlorine into the smoke at a temperature of 150°C. As can be logically expected, it was possible to detect both chlorine and mercaptan. In fact, chlorine cannot oxidize gases under such conditions. It was then believed that the chlorine would be much more efficient when acting on a saturated gas if the temperature was lower than the dew point. To try this (*12*), a small washing tower, 3 by 3 ft. and 13 ft. high, filled with bricks was built. About 115,000 cu. ft. per hr. of gases from the pipe after the chlorine gas was introduced were passed through this tower in which 100 gal. of water were circulated. The gases which came out were cooled and saturated. With the vapor contained in the smoke, corresponding to a vapor tension of 80 to 100 mm. Hg, the dew point oscillated between 47 and 52°C.; the temperature of the inlet gas might vary between 100 and 125°C.

Under the above conditions, however, a maximum temperature varying from 50 to 58°C. was reached, when sufficient water was introduced to compensate for the loss from evaporation; naturally if a greater quantity of water was let in, and at the same time hot water was drained off, the temperature fell.

While this is not the place to show the thermic action of the tower, the results of certain tests made under various functioning conditions are given in Table III, which confirm the above: the feeding of chlorine in the smoke corresponds to about 5.4 lb. per ton of pulp.

Table III

	Feeding flow, m.³/h.	*Smoke temp., °C.*	*Time, hr.*	*Temperature of water Start, °C.*	*Temperature of water End, °C.*	*Smoke temperature, end, °C.*	*Water flow, l./h.*	*Pressure, mm. Hg*
1	4760	105	2	..	..	54	..	739
2	4730	102	2	15	54	54	..	739
3	4660	98	1	15	52	52	..	735
4	4720	102	4	16	52	52	..	742
5	4900	116	4	16	55	55	1200	740
6	4750	104	0.5	18	42	42	5143	746
7	4660	98	0.5	18	52	52	1350	745
8	4700	101	2	20	54	55	..	746

The fixed temperatures are reached in a relatively short time. In all the tests from 1 to 5, the analyses of the outlet gases did not indicate the presence either of mercaptans or chlorine. The tests 6 to 8, made without introduction of chlorine, gave the results shown in Table IV.

Table IV

	CH_3SH	
Trial no.	*No washing, mg./cu. in.*	*Washing, mg./cu. in.*
6	121	84
7	96	64
8	96	75

This confirms the slight efficiency of a simple washing with water. Naturally, the elimination of mercaptans is less when the temperature of the gases is higher and the quantity of water is smaller.

In 1950 an attempt was made to spray water in the channel between the electrofilter and the chimney (see Fig. 3) adding chlorine at the same time. These trials had to be interrupted immediately as the antiacid tiles which cover the inner wall of the chimney were not completely tight and therefore water condensed on the walls passed to the external side of the chimney, threatening to corrode the cement and the iron frame of the chimney itself.

A tower of the same type as the one described above is now being built, to obtain smoke at dew point which can be treated with chlorine. After this treatment the temperature of the smoke will be increased to be certain that they will pass through the chimney without condensation and without any corrosion.

In the mill there are two boilers which burn natural gas giving a quantity of gas having a temperature of 160°C. and a volume equal to that from the black liquor B. & W. boiler. It is believed that it is possible to mix the saturated gases after washing with chlorine water at a temperature of about 60°C. thoroughly by means of a fan, with the gas from the natural gas boiler to obtain a mixture over the dew point which will cause no corrosion of the chimney. It is intended to perform the mixing using an ejector placed at the outlet of the fan, which would be crossed only by natural gas smoke and therefore would not require antiacid construction.

In short, it is believed that the problem of odors in a sulphate pulp mill has been completely solved using the following three measures:

1. Combustion of all noncondensable gases coming from digester relief and the blow by passing them through a natural gas burning boiler.

2. Complete oxidation of condensate coming from relief, blowing, and evaporation of black liquor by using this condensate as dilution waters in the first chlorination tower of the bleaching plant.

3. Oxidation of malodorous sulphur compounds still contained in the smoke from the boiler burning black liquor by first cooling the gases to the dew point, washing them with chlorine water, and then retreating them through a mixture with smoke having higher temperatures coming from other boilers.

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The author wants to thank here G. Bozza, professor of Tech. Phys. in the University of Milan (Polytech.), who assisted and directed him during the research work for this paper.

Received Nov. 12, 1953. Presented at the 7th Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Houston, Tex., Nov. 18–20, 1953.

The Efficiency of a Four-Stage Washer versus a Three-Stage Washer in a Kraft Mill

E. A. HARPER and F. C. PAUL

This paper presents the results obtained from a three-stage and a four-stage pulp washer over a period of a year of actual operation in a kraft pulp mill, and compares these results in an endeavor to ascertain the relative efficiency of the two pieces of equipment.

THE equipment covered by this paper consists of two sets of IMPCO brown stock washers. The no. 1 unit is a four-stage, 8 by 10-ft. vacuum pulp washer, operated at a daily capacity of 212 tons. The no. 2 unit is a three-stage 10 by 12-ft. vacuum pulp washer, operated at a daily capacity of 200 tons. Each unit is preceded by an IMPCO pre-knotter of the conventional type. A record of the flow of wash liquor to each stage of each unit is kept by recording flow meters. All liquor tanks are equipped with level recorders. The consistencies of the pulp sheet leaving each vacuum drum, the headbox consistency, and consistencies in the vats before each vacuum drum are determined by the laboratory.

OPERATION

The brown stock in the blow tanks is diluted by means of a control valve to a consistency of approximately 4.0%. The flow entering the pre-knotter is regulated and diluted to a consistency of 1.00 to 1.35% by means of manually operated valves located on the operating floor.

The vacuum pulp washer functions to form a continuous sheet of pulp with wash liquor or hot water being applied to the sheet as it passes over the drums. In multistage washers the countercurrent system is employed and this, of course, consists principally of two operations: first, dilution of the sheet in the vat to a given consistency and second, the forming of a sheet, or thickening of the pulp, on the vacuum drum and displacing the vat liquor with wash liquor or hot water from showers as the sheet passes over the drum. A uniform consistency of between 1.00 and 1.50% should be maintained on the feed and also in the vats before each stage. A higher or lower consistency will not form a satisfactory sheet. Usually, the slower the operating speed, the better the washing. The vacuum will be better as there is less tendency to form foam and pull air through the sheet. The lower limit of the speed however, is set by the capacity needed to maintain production.

A close regulation is a major requisite for good operation. Tank levels must be held constant and the rate of stock flow in balance; the amounts of wash liquor and wash water, sheet thickness, and speed of the drums are kept constant. For good washing at all tim is vitally important that the wash room be equi with vacuum gages, recording flowmeters, and level recorders; also a constant check of the per solids in the filtrates and a close control of the co tency to the washers should be maintained withi limits as mentioned above.

The amount of wash water added at the last is governed by two factors. First, the economic ance between the cost of evaporation of the water a and the resulting savings in soda salts, and seco the cleanliness and pH of the pulp desired by paper mill.

DISCUSSION

It will be seen from inspection of Table I tha pulp sheet leaving unit no. 1 (four stage) and unit (three stage) is almost identical. The consisten

Table I. Averages for One Year of Operation

	Unit No. 1, four-stage		*Unit N three-*	
Wash water, g.p.m.	311		335	
Tons air-dry pulp/hour	8.82		8	
Gallons of wash water/ton air-dry pulp	2116		239	
Residual Na_2SO_4/ton air-dry pulp	20.2		16.	
Residual total solids/ton air-dry pulp	31.7		25	
Residual total solids/ton moisture-free ($Na_2SO_4 \times 1.74$)	35.1		28.	
Washed pulp consistency	15.4		15.	
pH of washed pulp	10.175		10.	
Headbox consistency and % total solids in liquor	1.23	16.3	0.859	1
Consistency and % total solids in liquor, vat no. 2	1.35	7.28	1.10	
Consistency and % total solids in liquor, vat no. 3	1.61	2.03	1.14	
Consistency and total solids in liquor, vat no. 4	1.44	0.688		
Baumé of black liquor to evaporators	7.8°@179°F.		7.7°@1	

the sheet is exactly the same, 15.4%. The pH is tically the same, being 10.175 for no. 1 against 1 for no. 2. The saltcake loss is 4 lb. lower for n but the loss from both units is so low as to be al negligible. The efficiency of the removal of black li solids, as shown in Table II, is 99.87% for no. 1 and 99.93% for no. 2 unit, again practically the s The big difference, however, is in the amount of handled per hour and the amount of wash water n sary to obtain the same quality of pulp. Table I s that unit no. 2 requires 24 g.p.m. or 280 gal. per t air-dry pulp more than unit no. 1. Table II shows the dilution factor of unit no. 1 is 3.89 lb. of wate lb. air-dry pulp against 5.05 lb. for unit no. 2.

E. A. HARPER, Pulp Mill Superintendent, and F. C. PAUL, Chief Chemist, Hudson Pulp & Paper Corp., Palatka, Fla.

Table II. Washer Efficiency

	Unit no. 1				Unit no. 2			
	Consistency, %	Pounds solids/ton moisture-free pulp	Pounds solids/ton moisture-free pulp removed	Solids removed, %	Consistency, %	Pounds solids/ton moisture-free pulp	Pounds solids/ton moisture-free pulp removed	Solids removed, %
No. 1 vat consistency	1.23	26,180	0	0	0.859	38,590	0	0
No. 2 vat consistency	1.35	10,640	15,540	59.36	1.10	8,040	30,550	79.16
No. 3 vat consistency	1.61	2,480	8,160	31.17	1.14	700	7,340	19.02
No. 4 vat consistency	1.44	870	1,610	6.14	...	...	...	...
Washed pulp (residual total solids)	. .	32	838	3.20	...	25	675	1.75
Totals			26,148	99.87			38,565	99.93

	Dilution factor	
	Unit no. 1	Unit no. 2
Total wash water added, lb./ton air-dry pulp	17,626	19,959
Total liquor in washed pulp, lb./ton pulp	9,888	9,888
Total solids in washed pulp, lb./ton pulp	35	28
Total water in washed pulp, lb./ton pulp	9,833	9,860
Dilution water, lb./ton air-dry pulp	7,793	10,099
Dilution factor, lb. water/lb. air-dry pulp	3.89	5.05

CONCLUSIONS

From a comparison of the calculated results and the average data obtained from a year of actual operation under this mill's operating conditions, the four-stage washer adds 23% less water to the system than the three-stage while washing 5% more pulp to the same degree of cleanliness. For all practical purposes the solids in the washed pulp, the pH of the washed pulp, and efficiency of the washing operation can be assumed to be equal. The consistencies of the washed pulp are identical. If, then, the 5% difference in output is ignored as negligible, the ratio of the dilution factors becomes the measure of the relative efficiency of the two units and the no. 2 unit or three-stage washer is 77% as efficient as the four-stage washer.

It is only fair to state that under different conditions a different performance might be obtained. The operation described is governed by the pH requested by the paper mill.

Received Sept. 22, 1953. Presented at the Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Houston, Tex.

The Mechanics of Stress and Strain Occurring in a Fourdrinier Wire

JOHN D. LYALL

A method, for calculating the tensile and bending stresses induced in a fourdrinier wire, at the various positions around the fourdrinier, is presented, based upon experimental work using a model equipped with electric strain gages, from which it is possible to calculate the stress range through which the metal passes. A review of fatigue and fracture data establishes the range of stress that a phosphor-bronze wire will endure. Thus a means is provided for analyzing and designing wire runs, a guide is given as to the effects to be expected from changes in the wire specification, and a more precise understanding of the mechanics of the wire is obtained than has been available in the past.

The life of a fourdrinier wire is dependent upon many factors. There is the skill with which the metal has been fabricated; the care with which it is transported to and installed upon the machine; the manipulations of the machine tender, both skilful and otherwise; the chemistry of the solution in which it operates; and the range of stress imposed upon it by the orbit through which it must travel. Of these factors the stress range is the only one directly under the control of the engineer, and it is this stress and strain with which this paper deals.

The work upon which this paper is based was done in connection with a wire upon which insulating wallboard is manufactured. The wire is a plain woven fabric of 18 mesh composed of wires 0.020 in. in diameter and, as such, probably represents an extreme in coarse, heavy fourdrinier wires. The use of such a wire is limited; but the data presented are in such a form that by proper factoring, it may be applied to any plain woven wire. It, therefore, becomes a matter of wide application and, we hope, general interest.

Fourdrinier wires are subject to two separate conditions of stress. First, they are stressed as they are forced to flex around the rolls and, secondly, they must carry tension loads to perform the function of a conveyor and a power transmission belt. The total stress at any point in the orbit of the wire is the algebraic sum of these two stresses—the bending stress and the tension stress—while the stress range is the difference between the total stress at any two points.

THE BENDING STRESS

Figure 1 shows an enlarged, vertical section through

John D. Lyall, Project Engineer, Armstrong Cork Co., Lancaster, Pa.

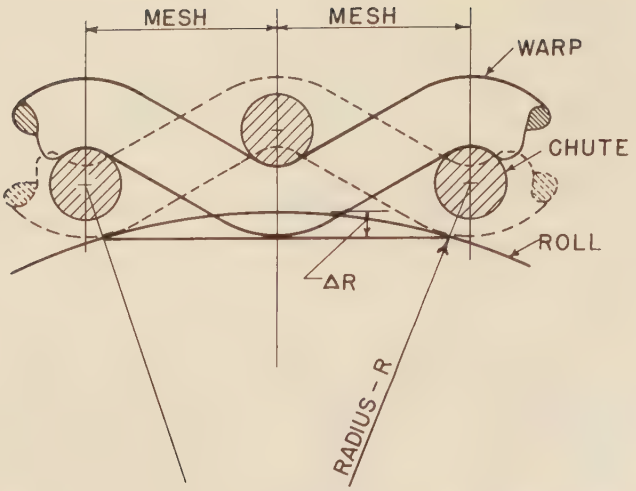


Fig. 1. Enlarged cross section of a typical plain woven warp wire

the fourdrinier wire and gives the relationship of the warp and chute wires. It is to be noticed that the warp wire alternates from one side of the fabric to the other as it passes over and under the chute wires. If the wire is bent around a roll of radius R, then the knuckle must rise an amount ΔR. In rising this distance the warp wire will flex at each knuckle, much like a partly opened folding ruler. The action is not one of tension on one side of the fabric and compression on the other, as occurs during the flexing of a belt or a book. From the geometry of the wire and the roll, ΔR can be computed for any spacing of the chute wires and any roll diameter and be plotted as shown on Fig. 2.

Figure 2 was computed on the basis of an 18-mesh wire, and any other mesh can be computed by factoring the ordinate. This curve shows that as the diameter of the roll is increased, the deflection ΔR decreases; and above a certain value the rate of decrease in ΔR is small, while the rate of increase in the diameter is much greater. A better understanding can be achieved, however, if this curve is converted to actual strain and stress.

The warp wire, as it passes around the roll contacting it at the knuckles, might be considered as being a continuous beam passing over a multiple number of supports. The beam would be curved, and the depth of the beam in proportion to the span would be great. To set up an equation for these conditions would be difficult; so to overcome this problem, we have resorted to the use of a model made out of a 1-in. diameter steel bar upon which electric strain gages were attached. The model was made to the dimensions and the gages located as shown in Fig. 3.

As shown in the photograph, Fig. 3A, the model was flexed in a hydraulic press and $\Delta R'$ the deflection in inches, and the strain in micro inches per inch, as given by the gages, was recorded. The knuckles were then ground off to simulate wear in $^1/_8$-in. increments, and the test repeated until 50% of the knuckle had been removed. The maximum bending stress was found to occur on the inside radius of the knuckle at gage no. 2. Then $\Delta R'$ and the strain, at gage no. 2, were plotted in Fig. 4 for the various degrees of wear.

The modulus of elasticity for bronze wire is quite variable and depends upon the composition of the bronze as shown in Fig. 7, compiled from data developed by R. M. Thurston for the U. S. Test Board and lished in A. P. Mill's, "Materials of Construct third edition. Because of this uncertainty samp warp wire were actually tested, and the modulus mined as being 13.6×10^6 p.s.i.; and this valu then been used throughout this investigation.

Figure 5 shows the maximum bending stress occu in the warp wire as it is bent around rolls of va diameters. This is arrived at by reading ΔR Fig. 2 for a particular roll diameter and multiply by the ratio of the model size/actual size to o $\Delta R'$, the equivalent deflection in the model. Th an 18-mesh, 0.020 in. diameter wire

$$\Delta R' = \frac{1.000}{0.020}\,\Delta R = 50\,\Delta R$$

Then the strain at this $\Delta R'$ in micro inches is d mined from Fig. 4 and multiplied by the modul elasticity (13.6×10^6) of the wire to give the stre the wire which is plotted over the subject roll dia to give Fig. 5.

It has been determined that these curves ma expressed mathematically by the formula:

$$S = KE\,\frac{D_w}{D_r}$$

where

S = unit bending stress in pounds per square inch
D_w = diameter of the wire in inches
D_r = diameter of the roll in inches
E = modulus of elasticity in pounds per square inch
K = a shape factor determined experimentally, de upon the shape of the wire and the amou knuckle is worn. Values of K for round with wear from 0 to 50% on the diameter wire shown on Fig. 6

Figure 6 showing the value of K for various amo of knuckle wear demonstrates, by the slope of the c a remarkably rapid increase in stress occurring point of 50% wear. This high rate of increase pro accounts for the fact that seldom is a fourdrinier worn materially beyond this point.

It should be noted that up to this point the ana of bending stress has been based upon the premise the wire fabric would be deflected sufficiently to only three warp wire knuckles in contact with th cumference of the roll. This defines a certain degr

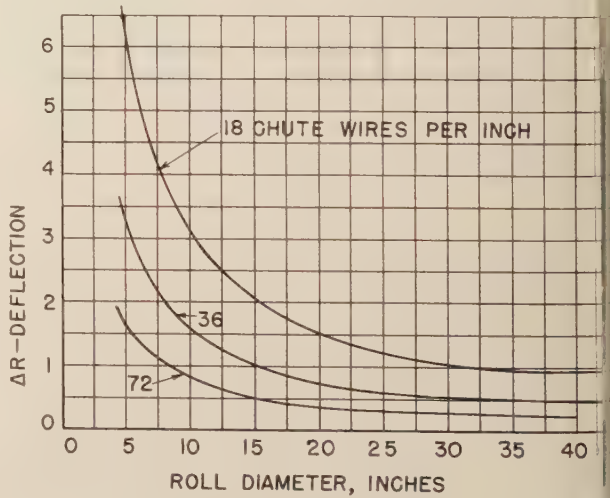


Fig. 2. Computed ΔR plotted against roll diamete 18, 36, and 72-mesh warp wire

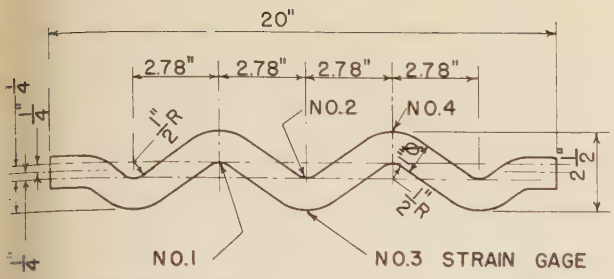
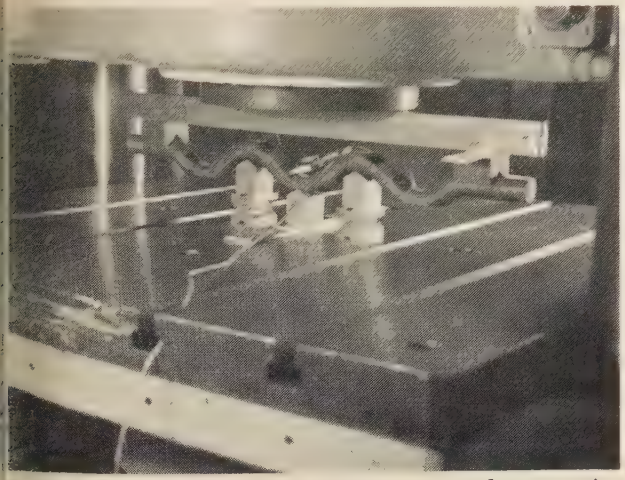


Fig. 3. Model of wire and location of strain gages

rvature in the fabric; and if the fabric were a solid, it uld also specify the strain produced regardless of any ther wrapping of the roll. However the fabric is not olid due to the warp alternating above and below the ıte wires. As successive knuckles are brought into ıtact with the roll surface, they transfer a certain ount of strain back into the preceding knuckle; so t, theoretically, the greater the wrap, the greater l be the stress. Actually from a practical standpoint amount of stress transferred reduces rapidly as the gression proceeds for each knuckle will pass on only ortion of the strain which it receives, and the amount stress passed on initially by the fourth and fifth knuckto the first knuckle is small. Attempts to measure s transfer of stress with the strain gages were unsucsful for even with a model factor of 50 to multiply the flections, the added deflection to bring the fourth and h knuckle in contact with the roll circumference is small, the resulting measurements were unsatisory. We, therefore, conclude that the increase in ss resulting from wraps greater than three knuckles small and may be safely neglected from most conerations.

The wire as it passes from one table roll to the next lows approximately the path of a parabola. The abola is tangent to the circumference of the table ls at the points of contact. Thus through the con- point of each knuckle a parabola can be erected, d the amount of sag in the center of the span comted. The sag may also be computed from the weight and the tension in the wire. Hence the two may be ated and the number of knuckles contacting the l approximated.

Figure 8 demonstrates a method for constructing the rabolic curve. Distance AB is laid off on the table ll equal to the distance from the centerline of the first



g. 34. Flexing of the 1-in. diameter steel warp wire model in the hydraulic press

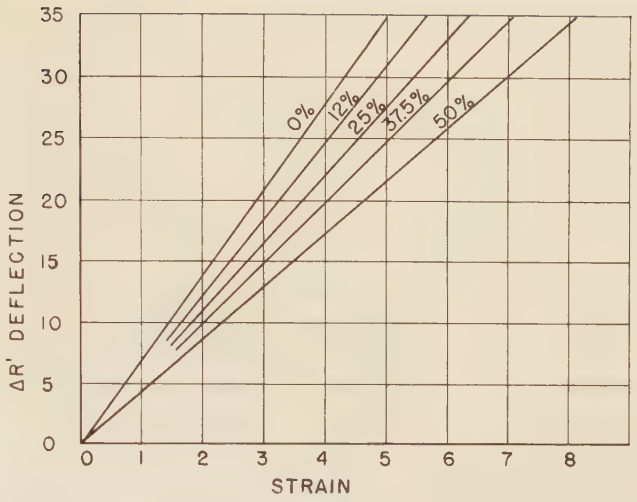


Fig. 4. Strain versus deflection—1-in. diameter deformed steel bar for various amounts of knuckle reduction—bar in bending—strain on inside of knuckle—deflection in 0.001 in.—strain in 0.001 in. per in.

knuckle to the centerline of the subject knuckle. Then Line BC is drawn tangent to the circumference of the table roll at point B. Line BD is then drawn vertically and line BF drawn such that angle FBC equals angle CBD, and the intersection of line BF and FC, the vertical centerline between the two table rolls, locates point F, the focus point of the parabola. Point D is then located on line BD such that BD equals BF, and the directrix of the parabola drawn through point D. Point J, the invert of the parabola, is located halfway between points E and F. Triangle HAN may now be drawn with AN perpendicular to HB, and line BO is drawn perpendicular to FE. Line AN is then parallel to BC, AH is parallel to FE. So angle HAN equals angle BCO and triangle HAN and triangle BOC are similar triangles. Line DF intersects BC at right angles for angle FBG equals angle DBG and line BF equals line BD in length. Thus triangle BGD is equal to triangle GBF which in turn, is equal to triangle CGF. Since angle FCG is common to these three triangles and triangle BOC, the four triangles are similar and are all, therefore, similar to triangle HAN.

In the range of dimensions under consideration, AN can be considered as being equal to AB. Then the dimensions of triangle HAN and the length of BO are known from which all the dimensions of the other triangles may be calculated by direct ratio.

Hence:

$$\frac{BO}{OC} = \frac{HA}{AB}$$

and

$$\frac{U/2 - AB}{OC} = \frac{HA}{AB}$$

$$OC = \frac{AB(U/2 - AB)}{HA}$$

Then since OJ equals $^1/_2\ OC$

$$OJ = \frac{^1/_2 AB(U/2 - AB)}{HA}$$

If

$$AB = {}^1/_2(N - 1) \div M$$

Then:

$$S = \frac{N - 1}{2MD_R}\left[U/2 - \frac{(N - 1)}{2M}\right] \qquad (2)$$

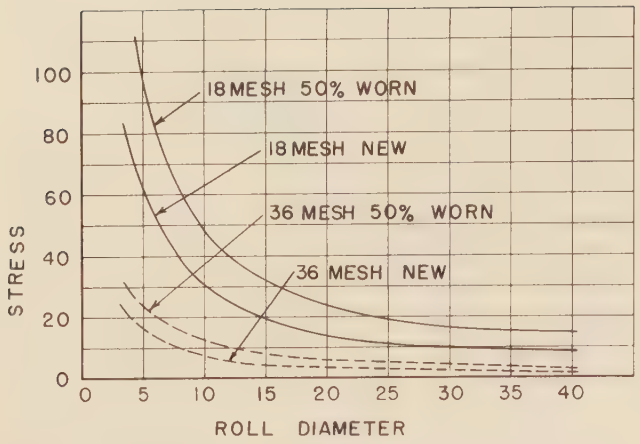


Fig. 5. Roll diameter in inches versus stress in 1000 p.s.i. for 18 and 36-mesh wires new and worn through the knuckle 50%

where

S = sag in inches
N = number of knuckles in contact with the roll
M = the mesh of the wire—openings per inch along the warp
D_R = diameter of table roll in inches
U = the distance from centerline to centerline of the table rolls in inches

The sag may also be computed from the tension in the wire, and the weight supported by the wire, using the equation:

$$S = \frac{L^2 W}{8T} \qquad (3)$$

where

S = the sag in inches
L = span in inches
T = the tension in pounds
W = the weight per inch of span supported by the wire and includes the weight of the wire

By solving equation (3) then substituting various whole numbers in equation (2) for N to obtain the same value of S from both equations, the number of knuckles contacting the roll is determined. If the number is three or more, then equation (1) for determining the bending stress is valid. If the number is less than three, the bending stress will be lower than that given by the equation.

It should be noted that a very substantial strain is induced in the wire by ΔR's that are relatively small. This emphasizes the need for keeping the rolls clean, free from dents, circular in shape, and smooth. Also the wire should be kept free from bulky, stiff seams, and patches.

THE TENSION LOADS

The fourdrinier wire must be stretched around the rolls with sufficient tension to form a level surface between the rolls and thereby provide a suitable mold for the paper. It must also act as a power transmission belt to transfer power from the couch roll to the various rolls in the fourdrinier, to rotate these rolls, and to pull the sheet across the suction boxes. This function imposes tensile stress on the warp wires.

The net power input at the couch roll is converted into so-called "effective" tension on the tight side of the roll; while on the slack side, there is an "initial" tension and the total tension on the tight side is the sum of the initial and effective tensions.

The effective tension may be proportioned arou fourdrinier to the various points that use pow either measuring each power requirement, or by m ing the total power input to the couch and remov adding various increments of the load. Thus the may be run without the wire to obtain the n power input; the wire may then be put on the m and run, and the load required to rotate the wir and the breast roll will have been added; stock then be put on the machine and the increment re to slide the wire under the apron and to rotate the rolls attained; the vacuum may then be turned suction boxes and the power obtained at v vacuums.

Figure 9 shows a bar graph of the tension distri on the subject insulating wallboard machine. effective tension computes to 30.6 lb. per in. of wire, while the gross tension input is 64 lb. rather high tension input is to be expected fo machine operates with high vacuums, a heavily l wire, and is run at low speeds. The current ten TAPPI Data Sheet No. 73-53 states that most ma operate with a gross tension input of 30 to 50 lb.

In order to produce an effective tension in the the wire must wrap and hug the couch roll with cient tightness to produce adequate friction to d the effective tension. The loading put upon th by a press roll, suction box in a suction roll, or a breaker roll, pressing it against the couch roll material benefit in increasing the tractive Further the force must be something greater tha minimum required to just produce the effective te for obviously the machine cannot operate safely point of imminent slip. Thus a certain amount of tensioning is required in the wire.

Several tests made on our machine have in that usually the operators set the initial wire such that without the benefit of the press roll, th is at or near the point of slip, and the pressure press roll on the wire gives the added frictional lo quired to give the margin of safety.

Assuming that this is, in fact, true, we can proceed to calculate the initial tension usin classical equation:

$$P = T_2 e^{aq} - T_2 = T_1 - T_2$$

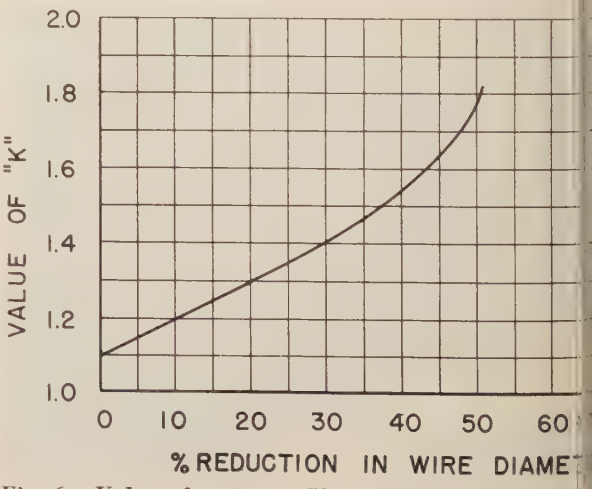


Fig. 6. Value of constant K versus per cent wear knuckle for warp wires of the proportions shown in

ere
= effective tension
= tight side tension
= slack side tension
= coefficient of friction
= angle of wrap in radians
= 2.718

ubstituting the data from the subject insulating board machine in this formula yields a value of lb. per in. width tension on the slack side and lb. on the tight side.

TENSILE STRESS AND DISTRIBUTION

hese tensile loads must be carried by the warp wires at the knuckles they will be distributed over the s-sectional area of the wire through the knuckle in a or less uniform pattern, depending upon the wear he outside of the knuckle and the radius on the in- of the knuckle. We have no factual information his distribution, at this time, but from other work ke nature are quite sure that the concentration is over 15%. Thus the tensile stress in a new 18 wire, with warps 0.020 in. diameter, and a loading 0.6 and 50.9 lb. per in. of width, will be approxi- ly:

$$\left[50.9 \div \pi\left(\frac{0.020}{2}\right)^2 18\right]1.15 = 10{,}300 \text{ p.s.i. on the tight side}$$

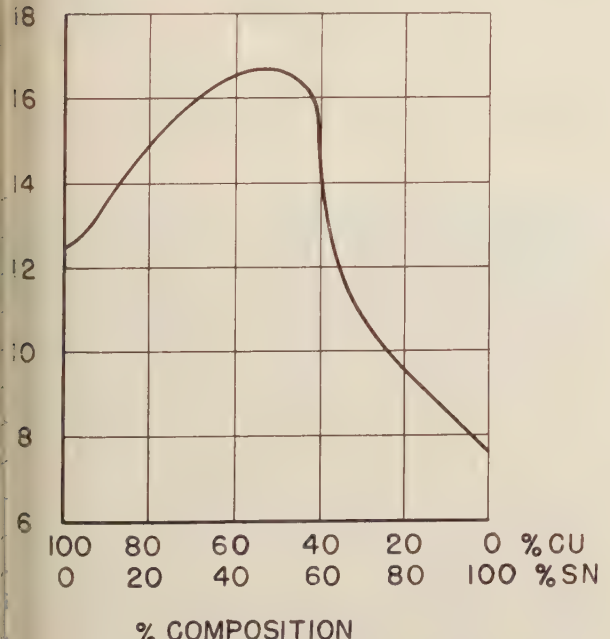
$$\left[20.6 \div \pi\left(\frac{0.020}{2}\right)^2 18\right]1.15 = 4180 \text{ p.s.i. on the slack side}$$

he knuckle wears, these values will rise in propor-

TOTAL STRESS

he total stress at any point in the wire is the alge- sum of the tensile and bending stresses at that t. If the tensile stress is assigned a positive sign the compressive stress a negative sign, they may dded and the total stress obtained.

t a point over a table roll the knuckle adjacent to the will be under tension load with the inside of the



7. Per cent composition versus modulus of elasticity in flexure for bronze, units 1,000,000 psi

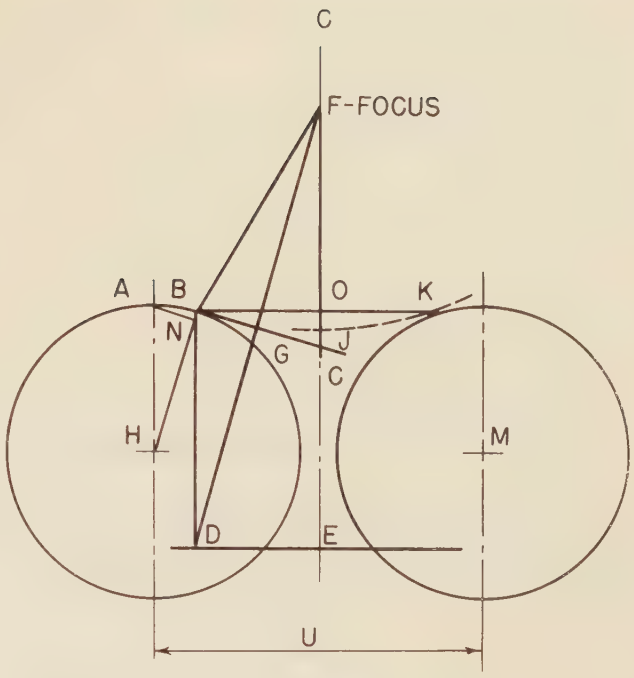


Fig. 8.

knuckle carrying 15% more stress than the average across the area, and the outside will carry 15% less than the average. The bending stress will be a tensile stress on the inside of the knuckle, and a compressive stress on the outside. Since both the bending and tensile stresses will be positive on the inside of the knuckle, the sum of these two will be the greatest on the inside.

At a point over an outside wire roll, the condition of the knuckle examined over the table roll is reversed. The tensile load will remain positive, but the bending will be in the opposite direction and will receive a negative sign.

Figure 10 shows the stress in the wire at the various points around the fourdrinier. It is to be noted that the maximum total stress in this case occurs over the table rolls, and not between the suction boxes and the couch roll in the area of maximum tensile stress. If the wire was bent over a guide roll located between the suction boxes and the couch, this would become the point of maximum stress only if the guide roll approached the diameter of the table rolls.

At the outside wire rolls, the total stress has a negative sign due to the negative sign of the bending stress which exceeds the positive value of the tensile stress. Thus the greatest range in stress occurs between the outside wire roll and table rolls.

Actually in practice the wire on this machine with a stress range of 85,000 p.s.i. when new to 95,000 p.s.i. when the wire is discarded, with 10% wear on the knuckles, passes through 800,000 to 1,000,000 cycles before failure. Burghoff and Blank (ASTM, vol. 43, page 775) predict the endurance of phosphor-bronze as being 1 million cycles at a stress range of 90,000 p.s.i., so we consider our methods to be substantially correct.

COEFFICIENT OF FRICTION

Actual field tests were made on the subject fourdrinier to determine the coefficient of friction that actually exists during operation, and the values listed

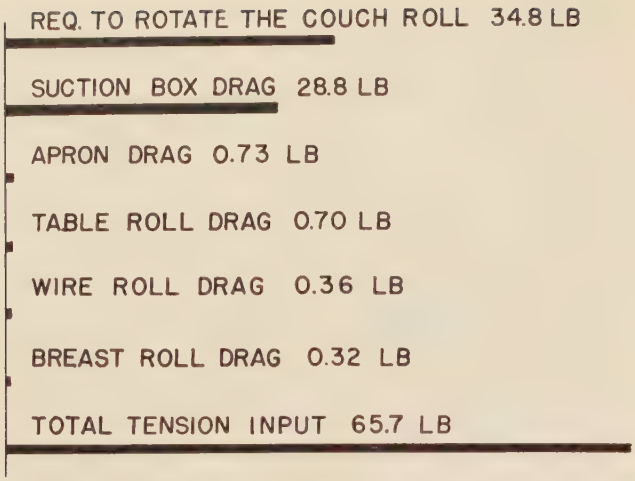

REQ. TO ROTATE THE COUCH ROLL 34.8 LB
SUCTION BOX DRAG 28.8 LB
APRON DRAG 0.73 LB
TABLE ROLL DRAG 0.70 LB
WIRE ROLL DRAG 0.36 LB
BREAST ROLL DRAG 0.32 LB
TOTAL TENSION INPUT 65.7 LB

Fig. 9. Distribution of tension input—pounds per inch width of wire at 21 f.p.m. for a 150-in. insulating wallboard fourdrinier while manufacturing $^1/_2$-in. thick board. Couch roll 34.8 lb., wire roll 0.06 lb., breast roll 0.32 lb., table roll 0.02 lb., apron drag 0.73 lb., Roto-Belt suction box drag per inch of vacuum per unit of three boxes 0.96 lb.

below were obtained. The tests were made by drawing strips of fourdrinier wire over the rolls with a dead weight on one end and a spring balance on the other to measure the loads. The coefficient was then calculated from equation (4). Wires of 18, 24, and 36-mesh, new and worn, were used; and it was found that the coefficient was independent of the mesh or degree of wear within the scope of these tests.

Item	*Description of surface*	*Coefficient of friction when wet*
1	Perforated 26-in. diameter couch roll shell, recently ground and slightly oily	0.157
2	Plain gun metal 26-in. diameter couch roll, quite rough and granular	0.288
3	Smooth 16-in. gun metal wire roll	0.23
4	$12^1/_2$-in. copper covered wire roll, in good condition	0.225
5	16-in. rubber covered roll, soft	0.60
6	Rubberized apron cloth	0.46
7	Rota-Belts, rubber versus stainless steel	0.125

FATIGUE AND FRACTURE

The photograph, Fig. 11, shows the fracture occurring in the warp wires of the fourdrinier fabric. It is interesting to note that this fracture is a sharp cleavage through the metal without indications of necking or draw down. It fractures as if it were a brittle material. Such a fracture is typical of a "fatigue" failure.

The term "fatigue" when applied to metals is probably a misnomer. It originated at the time that it was believed that metals, when subject to stress, underwent a progressive disintegration of the bond between crystals. Today we know that few failures occur between crystals. The mechanism of so-called "fatigue" failure is still obscure; however it is often explained as being a failure of the crystals through planes of shear. The metal is considered as being made up of many crystals, oriented in a random manner, some of which are larger, stronger, and harder than adjacent crystals.

When stress is applied to the metal, those crystals that are weakest in shear and located so as to receive the shear load, fail in shear; then the stress is ferred to adjacent crystals, and a continual re ment of the load goes on until ultimate failure Metals never fail in compression from fatigue; a failures are, of course, markedly influenced by s conditions, crystal size, and the magnitude stresses.

Many tests have been made to determine the n of cycles that bronze will endure under various but the variability in results from sample to sar so great that curves of fatigue resistance sho looked upon as life expectancy curves rathe definite limits. Figure 12 is a typical plot of suc

Gohn and Ellis (Proceedings, ASTM, vo show that when considering fatigue, the par value to which the metal is stressed is not so imp as the range through which the metal is stressed.

In their experiments they made cantilever out of strips of grade C phosphor-bronze 0.032 in. then flexed them by moving the free end of the through various arcs. Figure 13 shows a plot results of these tests. The two curves show the developed in the beam at each end of the arc a distance between the curves represents the stress that the metal endured for a life of 100,0 cycles. This stress range varies from 54,000 to p.s.i. The ultimate stress reached in the materia not appear to be important so long as the max stress does not exceed the yield value, and the loa not have to be of a symmetrical type. This, as w show later, is a very fortunate condition.

ANALYSIS OF PHOSPHOR-BRONZE WARP W

The phosphor-bronzes in general use for warp contain from 5 to 8% tin, the compositions approximately:

Tin	3.5%–5.8%	or	7.0%–9
Phosphorus	0.03%–0.35%		0.03%–0
Lead	0.05% max.		0.05% m
Iron	0.10% max.		0.10% m
Zinc	0.30% max.		0.20% m
Copper	95.75%–93.4%		92.6%–90
	100%		100%

Higher percentages of alloying materials te decrease the fatigue resistance until very heavy an

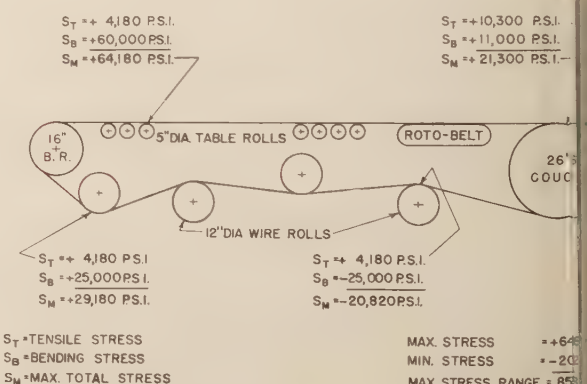


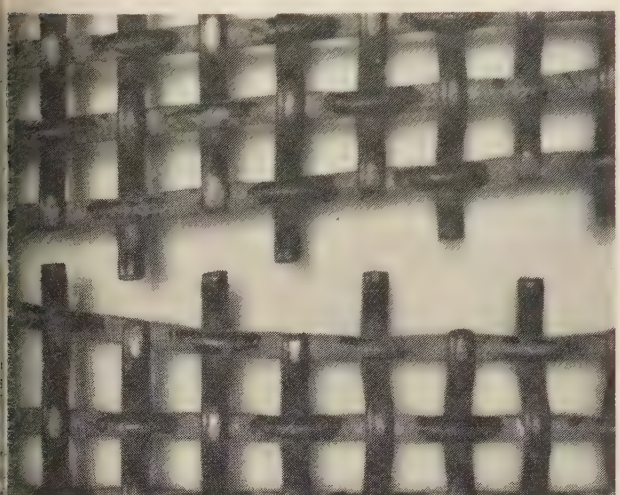
Fig. 10. Tabulation of tensile and bending stress ring in a typical fourdrinier used to manuf ing wallboard employing an 18-mesh, 0.020-in. dia warp wire

alloying are employed, and then the fatigue resistance es but does not markedly exceed the values obtained h low concentrations of tin.

A typical experimental stress-strain curve of a warp e before weaving shows that, in general, an elonga- n of 55 to 60% is employed to permit trouble-free aving; and the wire is in the fully annealed, bright dition. The wire during weaving is usually given "beats" in the loom. The first "beat" is a hard to form the warp wire around the chute and make knuckle. The second "beat" then pushes the te down into its proper relation to the adjacent te. During this process the metal on the outside of knuckle is strained above the yield point so that it omes plastic and flows to take a new shape. This working may elongate the metal on the outside of knuckle as much as 40 to 50%, and the character he metal at this point is altered.

igure 14 shows the stress-strain relationship through ch the warp wire knuckle passes as it is formed. rting at point A, the load increases in a slightly ving path to the yield point of the material at point Then the material becomes plastic, and it flows as d is applied to point C. If the load is now released, material will return along line C-D-E to the no load dition. There will then be a permanent strain of N d an elastic strain of O if the material is again loaded load G. It will proceed to G along path E-F-G, and area E-F-G-D represents the work done, which is sipated as heat. If the material is now unloaded, path will follow around the loop E-F-G-D. If the d goes above G to point H, the process will repeat and loop L-I-J-K will result. If loading then proceeds ve L to point M, the ultimate strength will have n reached, and the material will break. Thus with to 50% elongation taking place during weaving, we n be quite sure the knuckles are working in the area of ard drawn material, while the material between the uckles is operating at some lower point.

The first "beat" in forming the knuckle sets up this dition of a non-uniform strand and takes up the ain N; while the second "beat", no doubt, uses up me of the elastic strain O, thus leaving the fabric in a e-stressed condition. After weaving, the wire is then n on the stretching frame to level it and even out the ains so the wire arrives at the paper mill in a flat and



. 11. Typical fatigue failure of a fourdrinier wire

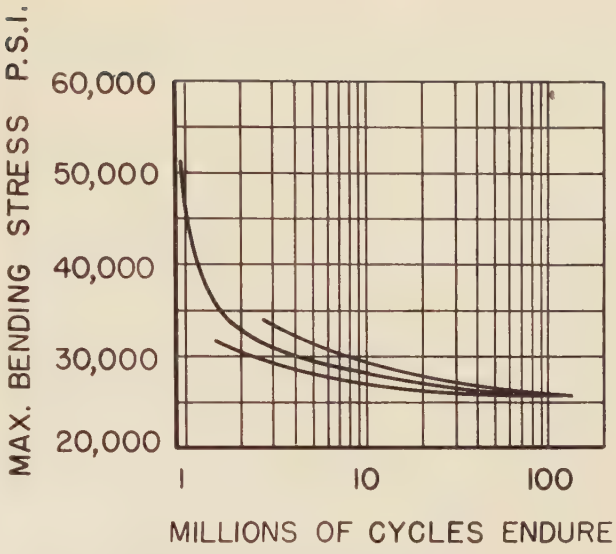


Fig. 12. Typical fatigue curve for phosphor-bronze showing maximum, minimum, and average values

pre-stressed condition. We know of no method for determining the amount of this strain, and it is certainly beyond the control of the paper machine designer. However its presence, fortunately, does not affect the range of stress that the wire can endure, but merely changes its location as it varies the mean stress (see Fig. 13). If it does not force the maximum stress above the yield point of the material, its presence does no harm.

DISCUSSION

Logically, though it is seldom done, the machine designer should start the design of the fourdrinier around the specification for the wire. The parts of the fourdrinier should then be proportioned such that the stress range to which the wire is subject will be uniform throughout its orbit and of a proper magnitude to yield optimum wire life.

On today's machines a careful analysis may well show up areas of over-design for recently the "fads" in paper mill equipment have been directed to the indiscriminate use of larger and larger roll diameters, often without factual information on the returns to be derived at each location. A complete revision of our thinking on the relative diameters of inside and outside wire rolls may well be in order for it is to be noted that inside wire rolls may be as small as table rolls without affecting the stress range; while outside rolls should be large so as to reduce the negative bending strain. Large diameters for breast rolls do not seem to be justified if the size is predicated upon the requirements of the wire only.

When selecting the diameter of the couch roll, it should be noted that couch rolls of even the smallest size induce bending stresses of a low magnitude so that the total stress at the couch normally does not control the stress range. Further the tractive effort produced by the roll is independent of the roll diameter *per se*. This force depends upon the wire tension, the coefficient of friction, the degree of wrap, and the loading produced upon the wire by the suction box or lump breaker roll. Where high tractive forces are required, the degree of wrap can be increased by the use of a large outside wire roll, and/or soft rubber coverings which increase the

coefficient of friction four to five times. The smaller rolls, of course, produce greater centrifugal effects, limit the size of the suction box, and reduce the degree of wrap.

Figure 9 demonstrates that wire wear greater than approximately 50% of the diameter of the wire cannot be reasonably expected. If this amount of wear is being obtained, greater economy can probably be achieved by changing the wire specification to a fabric made up from warp wires of larger diameter, or more warp wires per inch, or weaves that will present more metal for a wearing surface; all of which must be done in a manner that will be compatible with the wire's primary function of forming a suitable mold for the paper.

It is obvious that if the wire fabricators could form the fabric from a warp wire of non-uniform cross-section, there would be a possibility of wearing the knuckles below the 50% point. That is, if that portion of the warp wire lying between the knuckles could be deformed so as to reduce its section modulus and thereby make it more flexible, the flexing in the new wire might be made to occur between the knuckles. The point of strain would then move toward the knuckle as the knuckle wears, the strain and the fatigue would move over a long section of metal. Thus the rapid increase of the bending strain shown in Fig. 9 would be defeated. Conversely the same effect could be achieved if the knuckle could be thickened.

Stainless steel wires have been tried repeatedly in the past and always with dismal results for fractures have developed rather quickly. Substituting the high modulus of elasticity (29,000,000) and the low endurance strength (25,000 p.s.i.) of stainless steel in our equations quickly defines the trouble. Namely, it can

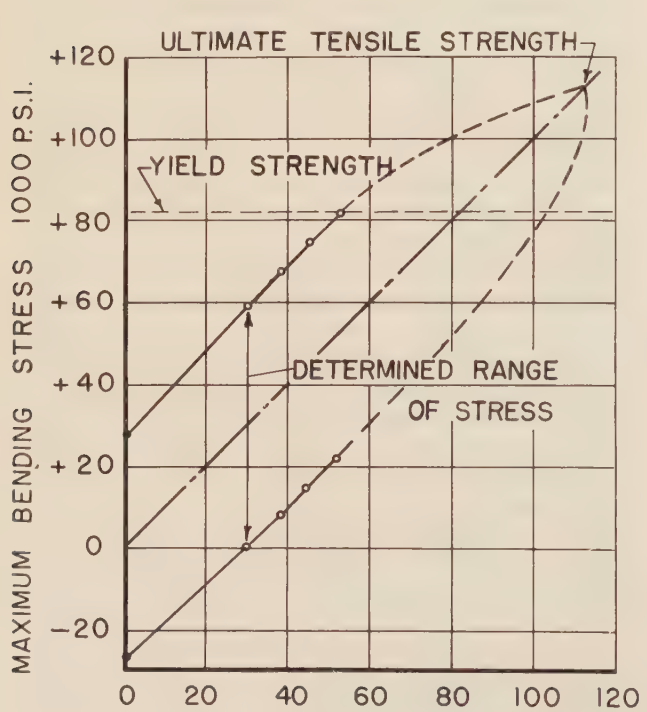


Fig. 13. The effect of mean stress on the range of stress in unsymmetrical repeated bending, endurance limit 100,000,000 cycles; material grade C phosphor-bronze strip 0.032-in. thick spring temper; reference—Gohn and Ellis, ASTM, Proc., vol. 47

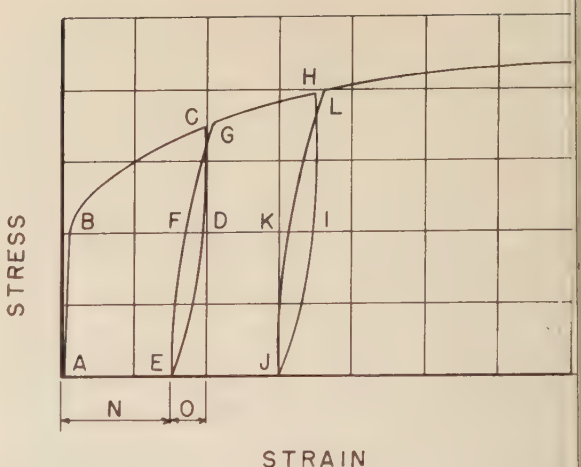


Fig. 14. Typical stress-strain curve for phosphor- wire, showing the effect of repeated tension lo

stand only about one-quarter the strain of pho bronze. If the use of stainless is desirable, we h that a wire run can be designed to cope with factors. The resulting machine might appear gro by present standards, but it probably would o satisfactorily.

CONCLUSIONS

It is concluded that by the methods developed paper, it is possible to compute the bending and stresses in a fourdrinier wire and that the compu of the stress range through which the metal in th must operate provides a valuable and useful tool engineer to assist in the design of the fourd the selection of wires, the comparison of designs, a making of alterations, all toward the end of f the one best combination of machine parts.

It is recognized that the scope of this paper is and it is hoped that other investigators will fro to time add to this knowledge.

Further improvements in fourdrinier wires and drinier wire runs will come only through a better u standing of the mechanics; and if this paper by cr a discussion of the problem between engineers, tors, and wire manufacturers, leads to an imp understanding, we are gratified.

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Received Oct. 15, 1953. Presented at the Eighth Engineering Con of the Technical Association of the Pulp and Paper Industry, M Que., Oct. 26–29, 1953.

The author takes pleasure in acknowledging his indebtedness to T. Bergen and Richard C. Culp for their valuable advice and for perf the strain gage tests, to E. N. Lee and D. C. Morris for supplying

information, and to the Armstrong Cork Co. for permission to publish paper.

DISCUSSION

You have done an exceptional job of analysis and e prepared a very interesting and well written paper ich should be of considerable interest to members of Technical Association. The paper is so well done t I find little to criticize, but there are a few points ch you might clarify before presenting the paper. first of these occurs where R' is determined by tiplying R by the ratio of wire diameters. It would n to me that since deflection is inversely proporal to the moment of inertia and since that is proional to the fourth power of the wire diameter, ratio should be in terms of the fourth powers ind of the first.

K. W. Brenner
Eastman Kodak Co.

he point which you raise concerning the linear ion which we have used from our model to our al wire, basing it upon the diameter of the wire, is upon which we do not have positive proof. The pose of experimental work, of course, is to make et measurements, rather than depending upon ry, and to really answer your question it would be ssary to make several models of different sizes and experiments on each. However after going over problem when we were setting up the experiment, did not feel that such would be required for it is sible to assume that the wire approximates the tionships that occur in a simple beam. If you are ling to make this assumption, it is then possible to up equations for simple beams which show that the ain is proportional to the depth of the beam.

n practice, our fourdrinier wire deviates only about e from a simple beam; and therefore we have been ling to assume that the relationship between R' and ould be in the same relation as the diameters of the e, or at least would deviate very little from it.

John D. Lyall

have a comment on strain which you made. "The et of maximum total stress occurs over the table s, and not between the suction boxes and the couch in the area of maximum tensile stress." This comt may be correct. From my experience I have er seen a wire break off the machine over the table section. This break usually occurs just at the at where the wire is leaving the suction boxes. ially when the wire breaks off at this point it is ause of damage of a mechanical nature, corrosion, erosion in the wire structure.

You also mention that "wire wear greater than roximately 50% of the diameter of the wire cannot sonably be expected." I believe a considerable unt of work has been done in the Canadian newst mills measuring caliper of fourdrinier wires. This aliper when new versus caliper when it is removed n the machine. This is not an accurate measuret because some decrease in caliper takes place use of stretching. However, I believe they have d a wire will take about 40% reduction in caliper and still be strong enough to run. The break point is apparently close to this figure.

F. O. Boylon
Crown Zellerbach Corp.

The point which you raise, namely, why does fracture of the wire occur between the suction boxes and the couch roll when the point of high stress is over the table rolls, is a very pertinent observation. The answer to this requires a bit of reflection, and the mechanism by which this fracture occurs is very interesting. First, we would like to point out that the occurrence of the highest total stress over the table roll section of the paper machine is not typical of all machines, for the location of this stress can be changed quite easily by changing some of the proportions of the fourdrinier. We believe that this case is quite typical of most machines with small table rolls of the older designs; however on the newer machines the point of maximum stress is probably after the suction boxes. In our particular case, if the wire was reduced to a 50 or 60-mesh wire and if the table rolls were increased in diameter to 9 or 10 in. and the vacuum on the machine lowered to 5 or 6 in., the point of maximum stress would move between the suction boxes and the couch roll.

I do not know just how valid your observation is that the final separation of the wire always occurs after the suction boxes, but I know that on our machine where we have the high stress ahead of the suction boxes, we do get quite a few fractures after the suction boxes.

Our explanation for this phenomenon lies in the fact that over the table rolls the wire is being subjected to a high bending stress and a low tensile stress, while after the suction boxes, the wire is subject to a high tensile stress and a low bending stress. Now according to our theories, the wire fails by fatigue, the fracture beginning as a small crack on the inside of the knuckle. Now over the table roll as soon as the crack develops in the knuckle, the appearance of the crack immediately eliminates the bending stress, and the wire is then subject to the tensile value occurring at this point. Then when the wire progresses across the suction box, the reduced section through the knuckle is subject to the high tensile values occurring in this area, and the fracture of the wire is completed. If the crack over the table roll should not be deep enough to cause the complete fracture after the suction box, then the cracked knuckle would proceed around the couch roll and over the table rolls until it was worked enough so that the crack would progress to a point deep enough to cause failure after the suction boxes.

John D. Lyall

The point which you bring up, namely, that a thin wire should bend around the roll with less stress than a thick wire, is exactly the conception that we had of this problem before we investigated it. When we ran into the results given in our paper, we repeated our tests very carefully to be sure that we were right. In the preparation of our paper, this point should have been emphasized; and we should have given our reasons for believing that it is correct.

The reasons why the stress rises as the wire wears lie

in the fact that the wear on the wire does not occur uniformly throughout the length of the wire, but rather occurs at the knuckles. As each knuckle wears, that portion of the wire which exists between the knuckles receives little or no wear; and as a result this portion remains relatively stiff, while the section through the knuckle becomes more flexible. Thus we have a wire that appears more or less like a string of bologna; and when it is wrapped around the roll, the relativ portions bend less than they did when the wire v and the deflection is concentrated at the thin por each knuckle. The result is a marked incr stress in the knuckle. This is the reason t likened the deflection of the warp wire to the w of a folding ruler around the roll.

JOHN D.

Sheet Formation on the Fourdrinier Machine

E. R. FINGER and Z. J. MAJEWSKI

A theory of the mechanism of sheet formation is presented. The factors of major importance governing sheet structure are considered to be intensive drainage zones at intervals along the wire, alignment of fibers due to acceleration of the stock, and drag of fibers in the direction of the relative movement of the wire to the stock. This relative movement varies periodically with shake. As a result of the above factors the sheet should be formed in layers, be three dimensional in character, have a waviness of structure determined by the shake condition, and have a type of lamination characterized by the difference in phase between the waves in different layers. A technique using cellulose tape has been developed to demonstrate structural features of the sheet. In this way evidence supporting the theory is presented. Some practical aspects of papermaking are discussed in the light of the theory.

SHEET formation on the machine wire has always occupied the minds of papermakers, and many investigations of this complicated process have been reported. These investigations have rather concerned special problems but no attempt has been made to bring the more or less known and accepted facts together, and to consider the process of formation by embracing simultaneously all the factors. In the following such an attempt will be described, and the resultant theory of sheet formation presented and discussed in the light of some known facts, and facts revealed by a new technique of demonstration.

FACTORS GOVERNING THE SHEET FORMATION

The mechanism of sheet formation on a fourdrinier wire machine, or in other words, the manner in which the water-suspended fibers are transformed into a wet web of paper, is primarily governed by the following physical phenomena:

Drainage

Water is rapidly removed from the stock at various narrow zones of drainage spaced at intervals along the wire. Consequently at each zone a layer of fibers is deposited on the wire or the mat of fibers already deposited.

The results of a study of fiber orientation, which is described in a later section of this paper, indicated rapid deposition of fibers at narrow zones of intensive drainage. This rapid dewatering is due to the fact that a rotating table roll and the moving wire const pumping unit. This concept of pumping acti been recently supported by Hood (*1*) who state "a table roll acts as a pump" and "a table roll diameter in contact with a wire moving at 500 produces a suction in the nip of about 18 in. of v Wrist (*2*) and Hendry, Mardon, Scruton, and V son (*3*) have developed mathematical theories roll drainage and supported them by experi work.

Stock Acceleration

In a zone of acceleration the fibers in the f stock tend to be aligned in the direction of the s lines. Moss and Bryant (*4*) demonstrated this ph enon by photographing the stock entering th from the headbox. Similar action must take p the drainage zones where the water, under the in of the suction exercised by the table rolls, is beir erated downward.

As a result the fibers contact the wire or the fibers already deposited with the leading end fir it may be expected that this alignment with v components will be retained in the deposited stat

Relative Movement of Stock and Wire

During the short period of deposition the fibers dragged in the direction of the relative movem the wire attain a preferred orientation accordi this movement. This is a generalized form of th originated by Lund (*5*) who said "Because of re speed between the wire (or the sheet already fo and the fibers, they will be dragged with the wire sheet already formed) in the machine direction."

It is suggested that the above-mentioned physical phenomena are the major factors i mechanism of sheet formation, but they are in influenced as to the degree of their relative effe other circumstances such as freeness of stock an tribution and uniformity of dispersion of the fib the stock prior to dewatering. But the influen these latter secondary factors can only modify the ing of the three major phenomena described. of the quantitative aspects of formation will b cussed in the later part of this paper and the foll description of the mechanism of sheet formatio therefore be of qualitative character.

E. R. FINGER and Z. J. MAJEWSKI, Research Engineers, Research Division Australian Paper Manufacturers Ltd., Melbourne, Australia.

ECHANISM OF FORMATION AND STRUCTURE OF THE SHEET

In the general case the stock leaving the headbox rough the slice is, within practical limits, evenly distributed across the machine. It is of uniform consency and has some degree of flocculation and fiber entation. The machine wire is moving at a slightly her speed and is shaken at a frequency between 150 300 oscillations per min. with an amplitude up to in.

ucture of the Bottom Layer of the Sheet

Within a very short time the stock passes over the zone of drainage, breast roll, or table roll as the e may be. Here a portion of water is rapidly exted, and, consequently a mat of fibers is deposited the wire, forming the bottom layer of the sheet.

The pumping action of the table roll introduces a inctive downward component of velocity, and in this e of acceleration the fibers tend to become orientated the direction of the streamlines. This downward ntation causes fibers to contact the wire with the ling tip first. From the time of contact the fibers dragged by the wire in the direction of the relative vement between the wire and the fiber. This tive movement will be considered in detail.

To an observer standing beside the wet end, the king movement of the wire appears to be negligible comparison with the wire speed in the machine tion. But when related to the fiber which is ied in the stock with the speed close to the wire d, the shake velocity is significant. This can be from the following example, in which the maximum city in the cross direction is calculated from the ke conditions and compared to the relative velocity ween the stock and the wire in the machine direction.

Assuming the following machine conditions:

Wire speed — V_w = 400 f.p.m.
Shake frequency — f = 250 shakes per min.
Shake amplitude — A = $^1/_2$ in.

It is normal practice to adjust the slice to give a ck velocity close to the wire velocity. Assume that k velocity is 10% less than the wire speed. The iation in cross-direction velocity due to the shake ely follows a sine law.

Maximum shaking velocity which equals relative velocity in cross direction — W_c max. = πAf = 32.7 f.p.m.
Relative velocity of stock and wire — W_m = 40 f.p.m.

It is thus apparent that in this example, which is e representative, the velocity component introed by the shake in the cross direction cannot be ected. This component following the harmonic ion of the shake varies periodically from maximum one direction over zero to the maximum in the osite direction.

When this variable component W_c is added vectorito the relative velocity in machine direction W_m, ch is constant, the resultant relative velocity W_r es in magnitude and direction at successive time vals.

Fig. 1 one full cycle of the shaking movement is wn. The periodicity of the cycle is $T_o = 1/f$. The ance by which the wire is displaced from a central position and the cross speed of the wire are plotted against time in Figs. 1a and 1b respectively.

Figure 1c shows the two components, W_c and W_m, added vectorially to give the resultant velocity of wire and stock W_r at eight equal time intervals, t. This graph shows the variation of drag which acts on the fibers as they contact the wire at various times.

The process of deposition of the bottom layer at various phases of one shaking cycle is shown in Fig. 2. The line A-A indicates the drainage zone. For the purpose of presentation it is assumed that all fibers are deposited in the instantaneous direction of the drag.

At the time $T = 0$ the cross speed of the wire is zero, the fibers deposited at that time will be dragged in the machine direction. During the time t, the wire has traveled a distance d, equal to the product of the wire speed, V_w, and the time t, i.e., $d = V_w \times t$. The row of fibers extending over the full width of the machine deposited at zero time have been carried this distance d from the drainage zone. At the time t, the resultant velocity is W_r (Fig. 1c), which is at angle θ to the machine direction. The fibers being deposited at the drainage zone will be orientated in this direction. The fibers deposited in the meantime have been deposited in intermediate directions.

During the next time interval t, the wire has traveled further distance d, carrying with it the fibers deposited. Those deposited at zero time are now a distance $2d$ from the drainage zone, and those deposited at time t are a distance d from the drainage zone. The speed of the shake V_c is a maximum, and the angle θ_2 which the resultant W_r makes to the machine direction is a maximum. The fibers being deposited at the drainage zone will be at maximum deviation from the machine direction.

This process continues at successive time intervals, fibers already deposited being carried on with the wire as further strips of fibers are deposited at varying angles to the machine direction at the drainage zone. This is represented graphically in the remaining sections of Fig. 2.

Gradually a wavylike form of structure emerges. The period length of this waviness equals the distance traveled by the wire in the time of the full shaking cycle, T_o, that is:

$$L_o = V_w \times T_o$$

In practice we do not find that all fibers are finally deposited in the direction of the resultant velocity. This would be the case if the contact between the fibers and the wire were sufficiently firm to prevent any slippage, and if the surrounding water and fibers did not resist the change in direction. The direction of drag is only the direction toward which the fibers tend to be aligned, and towards which any existing perferred direction of directional distribution curve of fibers will be diverted. If the fibers have been randomly distributed before the deposition, a preferred orientation will be created by the drag and in its direction.

Structure of Upper Layers of the Sheet

At each of the following drainage zones subsequent layers of fibers will be deposited. The mechanism of their formation is the same as for the bottom layer, the quantitative differences being:

1. Each layer of fibers already deposited increases considerably the resistance to drainage, so that the amount of water being extracted diminishes rapidly over the first table rolls, and accordingly the thickness of layers deposited decreases. Toward the top of the sheet the term "layer" becomes inapplicable because in most cases the sheet of paper is only a few fibers thick and, taking into consideration the usual number of drainage zones, the thickness of the layer would be less than the thickness of a fiber. So the upper part of the sheet cannot be expected to be built up in distinctive layers.

2. The direction and magnitude of the relative movement vary as the stock moves toward the suction boxes. The cross-speed component, being proportional to the amplitude of the shake, decreases with it, but also the machine direction component decreases as the stock is being gradually accelerated to the speed of the wire. As both components become smaller the magnitude of the drag decreases. The angle of drag will increase if the machine direction component drops more sharply than the cross component and will decrease in the reverse case.

3. The degree of fiber orientation and the degree of flocculation can undergo slight changes during the travel between the drainage zones.

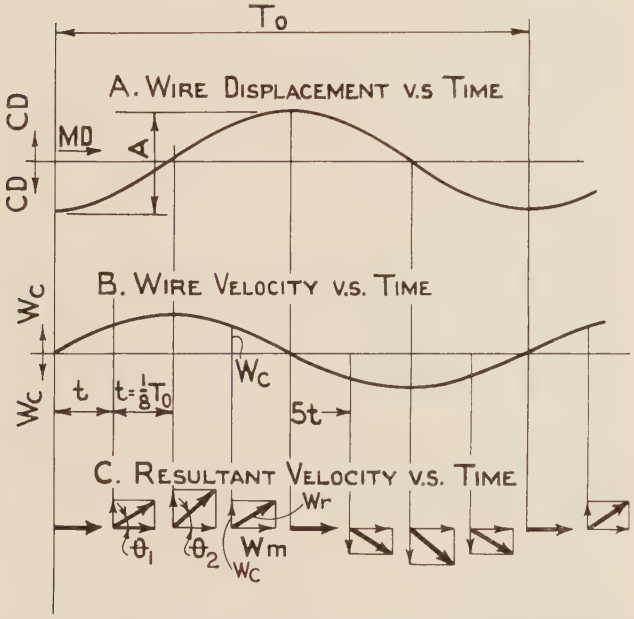


Fig. 1. Effect of shake on relative movement stock to wire

Another difference in the conditions of the deposition of the upper layers from those at the bottom is that those already deposited do not constitute such a clearly defined surface as the wire presents to the bottom layer. The dragging forces are transmitted fiber to fiber instead of from metallic wire to fiber. Also, in the time of travel from one drainage zone to the next, the water in contact with the deposited layer would tend to float the upper ends of the fibers. Thus there can be a great difference in the drag conditions.

The combined effect of the factors discussed above on the clarity of the waviness in the layers next to the bottom layer cannot be easily assessed and presented in the form of a statement of general validity. However, present investigations indicate that the clarity ishes. For the upper portion of the sheet wavi not exist because a layer is formed over a nur table rolls as a result of a very low rate of drai

Under all the restrictions mentioned above can be expected that a sheet of paper is b in layers in which the direction of preferre orientation varies periodically. The wavelengt same for all layers as it depends on the wire sp shake frequency which are both constant unde operating conditions.

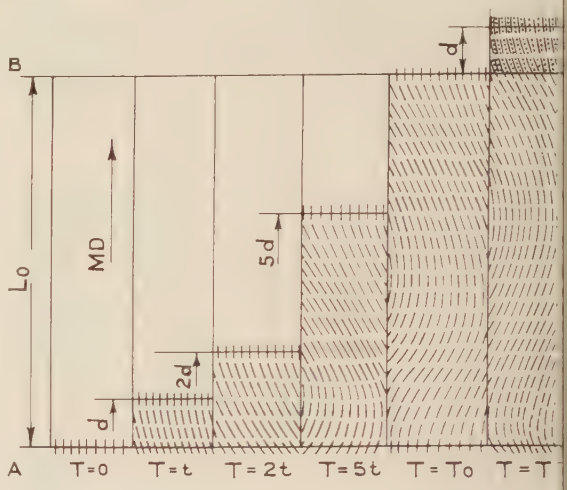


Fig. 2. Progressive deposition of a layer at one zone

This waviness of the layers is a very int feature of the structure of the sheet. The wav substantially sine curves can be deposited on ea in phase or out of phase. First the simple deposition in phase will be described. It can b Fig. 2, that after a full shaking period, the s posited at the time $T = 0$ has traveled a c corresponding to the wavelength L_o. The san of movement of the wire is then repeated. If distance L_o from the first drainage zone, a secon age zone were introduced (line B-B), a secon would be deposited on top of the first under pra the same drag conditions. Therefore the direc preferred orientation of fibers in both layers w parallel to each other in both layers.

This process has been presented graphically i for the times $T = T_o$ and $T = T_o + t$. The cov the bottom layer by the second layer is indic sudden thinning of the lines. The broken hea represent the second layer deposited over the layer.

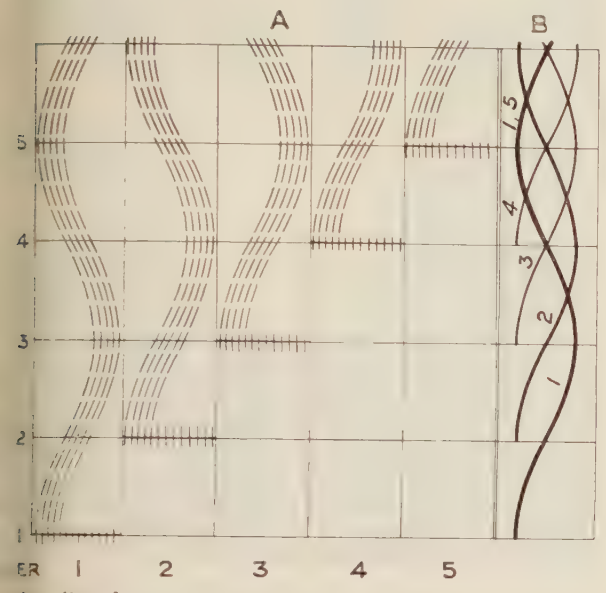
If the distances between the further drainag were also maintained equal to the wavelength, subsequent layers would show parallel w throughout the sheet.

Exactly this same sort of lamination can be o if any full number of shaking periods takes pla time of travel between two successive drainage z

Another type of lamination is presented in In this case, a deposited layer reaches the next d zone in a quarter of a shaking period. Fi illustrates the first five drainage zones. Eac has been shown separately, instead of one ab

ier. All the layers are considered at the same ment of time, so that at the moment of deposition at h drainage zone, they are under the same drag con- ions. At the moment illustrated in Fig. 3a all fibers being deposited when the relative cross speed is).

t can be seen from the graph that, for example, the o at the fourth drainage zone, onto which the fourth r is being deposited with no cross component, is t up as follows. The first layer has been deposited er maximum drag to the left, the second layer with ross component and the third layer with maximum



3. Simultaneous deposition of layers at consecutive drainage zones

to the right. This kind of lamination, in contrast he lamination in phase discussed above, gives ation in the direction of drag under which the ent layers were deposited.

igure 3b gives a simplified picture of the type of nation obtained in this case. A similar type of nation will result in cases where any uneven number arters of a shaking period takes place between two essive drainage zones.

or machines with even spacing between the drainage s the following formula can be used to determine kind of lamination under any specific operating itions.

$$K = \frac{S}{L_w} = \frac{S \times f}{V_w}$$

..

= phase factor indicating shift in phase in adjacent layers
= distance between two successive zones of drainage
= wavelength
= shake frequency
= wire speed

ne three most distinctive kinds of laminations will btained for the following phase factors:

= 1, 2, 3, . . .
= 0.5, 1.5, 2.5, . . .
= 0.25, 0.75, 1.25, . . .

most commercial machines the distance between reast roll and the first table roll, which are the first drainage zones, is larger than the distances between the following table rolls. This gives a different shift of phase between the most distinctive first two layers and the following layers, greatly disturbing any systematic lamination.

EVIDENCE SUPPORTING THE THEORY

The above theory has been developed in an attempt to explain results obtained from a study of fiber orientation in a machine-made paper, and these facts will be discussed in the light of the theory. Further evidence will be presented.

Fiber Orientation in the Sheet

As part of a study of the influence of machine variables on fiber orientation and physical properties of paper, a study of fiber orientation was carried out substantially on the lines described by R. Danielsen and B. Steenberg (*6*).

The numbers of fibers oriented at any angle were counted and plotted on radial coordinates to give a curve showing the directional distribution of fibers.

Before plotting their curves, Danielsen and Steenberg added together the fibers oriented at corresponding angles in each quadrant, plotted the curve from $-90°$ to machine direction and then drew the mirror image to complete a symmetrical curve. The authors added the fibers in opposite quadrants, because θ and $\theta+180°$ are in effect the same, and then plotted their results form $-90°$ to $+90°$ from machine direction. Although the numbers of fibers counted varied between 2000 and 3200, the curves were not very regular. However, the distribution curve for a paper produced without shake

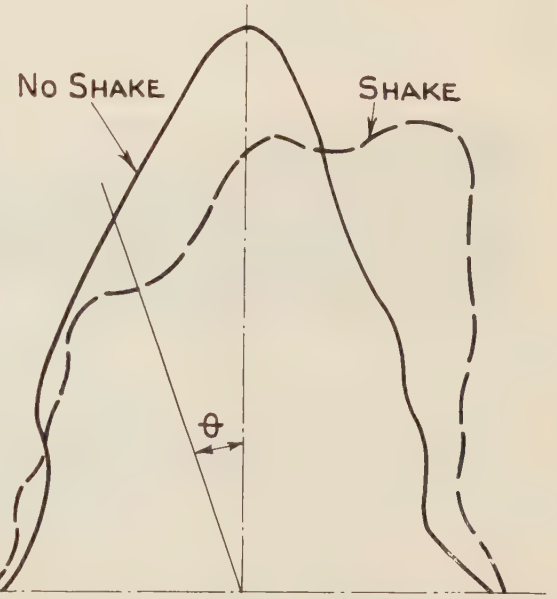


Fig. 4. Directional distribution curves of fibers in a sheet of paper

could be regarded as symmetrical about the machine direction, whereas with shake the curves showed a definite asymmetry. In Fig. 4 two typical curves are illustrated. Bearing in mind the theory and the fact that the samples examined were strips across the machine of only about 1 in. width, a strip, taken at random with shake operating, may have been formed under a drag, whose direction differs considerably from machine

direction. A symmetrical distribution curve can be obtained only if the area under examination extends over one full length of a shaking period. However, such a curve will represent only an over-all orientation, as there can be great variations for strips across the machine inside this length. Therefore, to obtain a true picture of the fiber orientation it would be necessary to evaluate individually a number of strips covering at least one quarter (half or full) of the length of a shaking period.

Three-Dimensional Structure of the Sheet

The results of fiber distribution examination strongly indicated the existence of waviness in a sheet of paper. On the glazed surface of kraft or natural sulphite papers which show a pattern of fiber, the wave is discernible but only with difficulty. The authors, therefore, sought a method of clearly demonstrating the existence of this waviness. At that time a colleague demonstrated that if two pieces of transparent tape are placed side by side on a piece of paper in the machine direction, and then pulled off in opposite directions, there is a difference in the number of fibers adhering to the tape. Figure 5a illustrates such an experiment. Two strips of adhesive tape have been placed parallel on the paper, pulled off, and replaced against a black background.

The remarkable difference in the number of fibers removed from the structure of the sheet can be explained only by existence of a vertical component of direction of fibers in the sheet. In Fig. 5b the cross section of the sheet of paper is shown diagrammatically. When the tape is pulled off in the general direction in which the fiber tips emerge at the surface, only a very few fibers are removed. The tape skims over the paper with only a surface effect, because the adhesive forces are too small to remove the interlocking fibers which are real

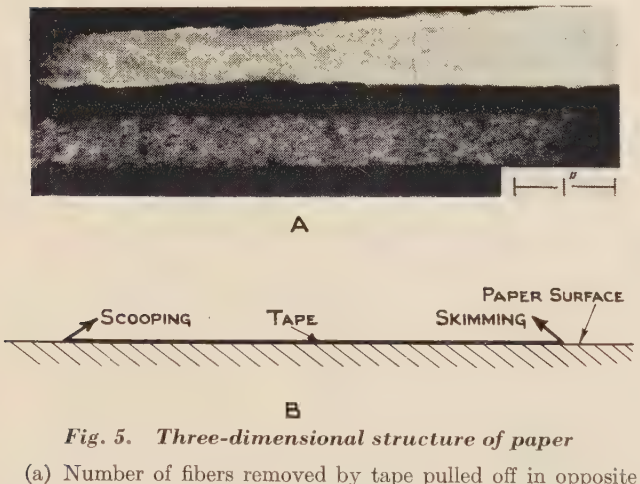


Fig. 5. Three-dimensional structure of paper

(a) Number of fibers removed by tape pulled off in opposite directions. (b) Diagrammatic cross section of a sheet of paper explaining this difference.

structural members of the sheet. However, when pulled off in the opposite direction, the tape gradually digs into the sheet. At the start, the fiber tips are lifted from the surface and so, without being removed, cause an initial lift, or deformation which steadily increase until the adhesive forces are sufficient to break completely the bond between the fibers and they are scooped out.

The amount of difference in the numbers o adhering to the tape varies from paper to pap some cases, when the paper is produced on a sl chine with many small table rolls and a very sl of drainage, no difference is observed, indicati the fibers are laid down horizontally. In othe practically no fibers are removed when the

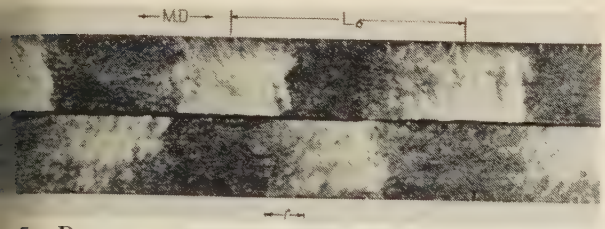
Fig. 6. Variation in number of fibers adhering pulled off at different angles

pulled in one direction, whereas in the other d many fibers have been scooped out to such a that the sheet is torn right through within a fe Such is the case when the fibers are at a high the surface of the sheet. With such a rem difference in the effect in opposite directions, interest to examine the effect at any intermediat Figure 6 illustrates an experiment in which p adhesive tape have been placed radially on a sheet of M.G. litho, pulled off radially tow center, and then replaced in their original against a black background. It is seen that o is densely covered with fibers, which have on scooped out over the area of the strip. The dire this strip is the direction of preferred orientatio fibers. This supposition is confirmed by exam of the neighboring strips. Here the scooping the fibers deviates from the direction of pulli takes place in the preferred direction leaving th edge of the paper completely free of fibers. This ment shows that, in order to obtain the scooping it is sufficient to have only a small componen pull acting in the preferred direction of the fibers

Waviness

These findings are very useful in demonstra existence of waviness in a sheet of paper. In strips of adhesive tape 2 in. wide have been adjacent to one another in the machine directio

n the edges toward the center, and replaced against ack background. There is a regular variation in the nber of fibers adhering to the tape. This is ex- ned by waviness in the formation. When the fibers nt up with a component of their direction toward the ction from which the tape is being pulled the fibers scooped out of the sheet, whereas when they point y from the direction of pull the tape skims over the



7. Demonstration of waviness of sheet structure

chine speed, 137 f.p.m. Shake frequency, 275 shakes per

The waviness appears very clearly, as any dense on one tape corresponds to a light one on the other vice versa.

.e effect of shake frequency on the waviness is n in Fig. 8. Samples were taken from the machine fferent shake frequencies, all other operating con- ns being constant. The highest frequency gave hortest length of a shaking period, and the lowest ency the longest length. The measured lengths n complete agreement with the theoretical values lated from the equation $L_o = V/f$.

series of samples were examined with constant e and increasing machine speed. As the speed d from 300 to 1000 f.p.m. the wavelength increased an initial value of 10 in. in agreement with the retical predictions. As the wavelength increases ariation in numbers pulled off becomes less obvious the resultant velocity varies less and less from the ive velocity in the machine direction; in other ls the effect of the shake component at normal shake iencies becomes less with increasing machine speed. fference in stock-wire speed equal to 10% of wire l is 100 f.p.m. at 1000 f.p.m. wire speed as against p.m. at 300 f.p.m. wire speed, while the maximum ity due to shake remains of the order of 30 f.p.m.

iere are other factors which diminish the clarity of vaviness. A very slow machine with many small rolls spaced very close together does not produce tectable waviness. The rate of drainage at the rolls is so low that possibly from the very begin- no distinctive layer is deposited at one roll. How- the quality of the paper is highly praised.

a high-speed machine, turbulence in the flow luces further irregularities because velocity varia- due to turbulence may be of a higher order than ross velocity due to shake.

nar Structure of the Sheet

peculiar paper made some years ago was recalled g a discussion on this subject. Looking through paper strips of good formation and bad formation be clearly seen. The strips of about 5 in. width ng in cross direction were visible over the full of the machine. The phenomenon disappeared n as the shake frequency was altered. A sample of such a paper viewed by transmitted light is shown in Fig. 9. Such formation is an excellent example of the lamination in phase, badly formed strips having been deposited on badly formed strips belonging to the previous layers, and well-formed strips on good ones.

Well and badly formed strips present in one layer may be expected if, first, there are flocs in the stock and, second, if there is no difference between the stock and the wire speed. The relative speed in the machine direction being zero, the resultant relative movement equals the cross speed of the wire introduced by the shake. When the cross speed is zero or close to it, no dragging action is exercised on the fibers and the flocs are deposited on the wire preserving their form. During periods of effective shaking movement, a drag sufficient to pull the fibers out of the flocs is acting, and so a well-formed strip is obtained. If the shake frequency is altered, the strips of bad and good formation overlap and the formation, although in absolute terms not improved, is at least uniform.

At first sight it is surprising that such a formation is not obtained more frequently, as there are definitely many machines producing well-formed paper laminated in phase. Besides the shake frequency necessary for the lamination in phase at a given machine speed, the two conditions mentioned above, regarding the stock speed and easily dispersible flocs, must be fulfilled.

The experiments described in this section show that a sheet of paper possesses the structural characteristics as expected from the proposed theory. The fibers are deposited with a vertical component as a result of acceleration acting on them in the zones of drainage. The wavy formation is a reflection of the varying relative movement between the stock and the wire. This is a result of effective dragging by the wire and also an intensive drainage which causes rapid deposition over narrow zones.

INFLUENCE OF MACHINE FACTORS ON THE STRUCTURE OF THE SHEET

Shake

The machine wire shake is generally regarded as beneficial to the formation and properties of the sheet.

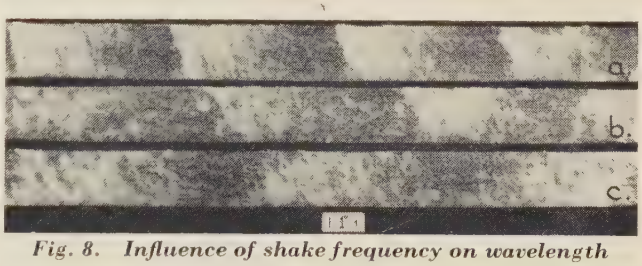


Fig. 8. Influence of shake frequency on wavelength

Machine speed, 137 f.p.m. Shake frequency: (a) 275 shakes per min.; (b) 240 shakes per min.; (c) 184 shakes per min.

The extent to which the formation can be affected is shown in Fig. 10 where two samples, one made without shake and the other with shake, obtained within 3 min., are photographed. Although such differences cannot be expected in every case, these samples show clearly the necessity to apply shake to the machine wire. However, on high-speed machines the effect of shake is greatly reduced and is frequently not applied.

The action of the shake is twofold. It acts on the fibers remaining in the mobile, suspended state and during their deposition, it introduces into the drag a cross component which leads to the waviness. These two cases should be considered separately. Although both affect the fiber orientation and degree of flocculation, the effect of one can be neutralized by the other.

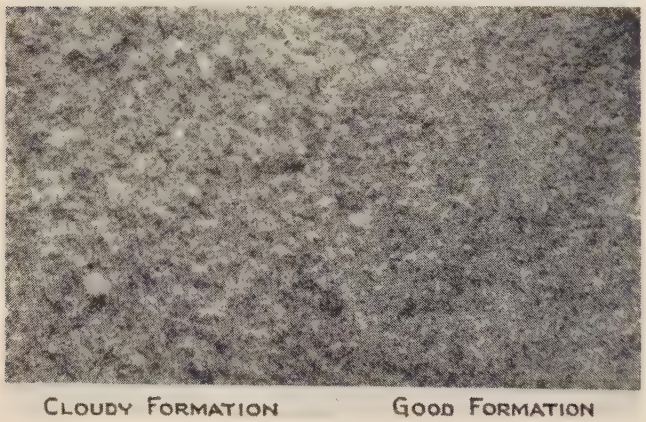
No definite answer can be given about the effects of the shake on the fiber orientation in the suspended state. Danielsen and Steenberg (*6*) have found in one paper increased fiber orientation in the machine direction produced by shake whereas the authors have found the reverse to be the case in their samples. These apparently contradictory results may be due to various factors such as the conditions of the fibers, stock, shake, drainage, and the like. On the other hand, the results of the counting of fibers in a paper made with shake must be treated with reserve, unless the principles laid out earlier in this paper have been observed.

During the deposition phase the wavy formation of the layers is developed. The preferred direction of fiber orientation deviates periodically from the machine direction. Considering a full shaking period this preferred direction should be less accentuated than in the case without shake.

With regard to the influence of the shake on the waviness, the two variables (frequency and amplitude) have to be considered separately. The increase in shake frequency, although causing proportional increase in the cross speed, also causes a corresponding decrease in the period length of the wave and so shortens the time in which the increased cross component is acting. As a result the amplitude of the wave is affected very little, or not at all. On the other hand, a change in the amplitude of shake must affect the amplitude of the waviness, as it influences the cross component, whereas the time during which the drag is acting remains constant.

Stock to Wire Speed Ratio

General practice for high-speed machines is to run

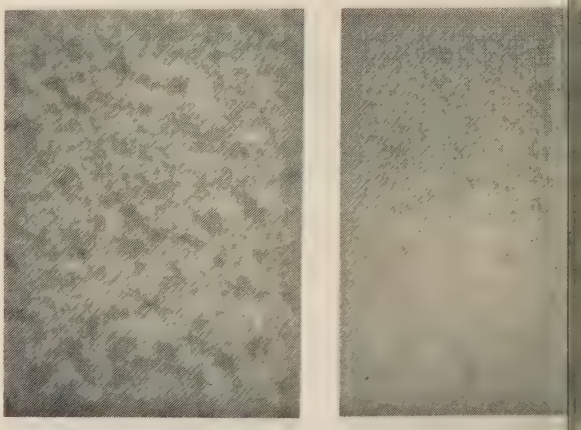


CLOUDY FORMATION GOOD FORMATION

Fig. 9. Lamination in phase

the stock onto the wire at a speed approximately 90% of the wire speed. For slow-running machines, the stock velocity may have to be slightly higher than that of the wire (*7*).

When stock speed is close to wire speed there is only a very small relative velocity in the machine direction so that the cross component due to the shake is much more effective. The deviation from the machine dire the resultant relative velocity increases and so t of the drag varies within much larger limits. example given previously for the relative vel M.D. of 40 f.p.m. and cross speed 32.7 f.p.m. th mum deviation was $\theta = 39°$. If the differ speeds of the wire and stock is reduced to 20 f.p angle becomes 59°. The result will be an in



NO SHAKE SHAKE

Fig. 10. Effect of shake on formation

amplitude of the waviness and in this light, cl stock to wire speed ratio close to one could be as an attempt to make the sheet "squarer."

In Fig. 11, influence of stock speed on the wav illustrated. By close observation the variation ferred direction of fiber orientation can be se this case the stock was moving faster than the w therefore at the lowest stock speed nearest to t speed this angle is a maximum. It decreases v creasing stock speed.

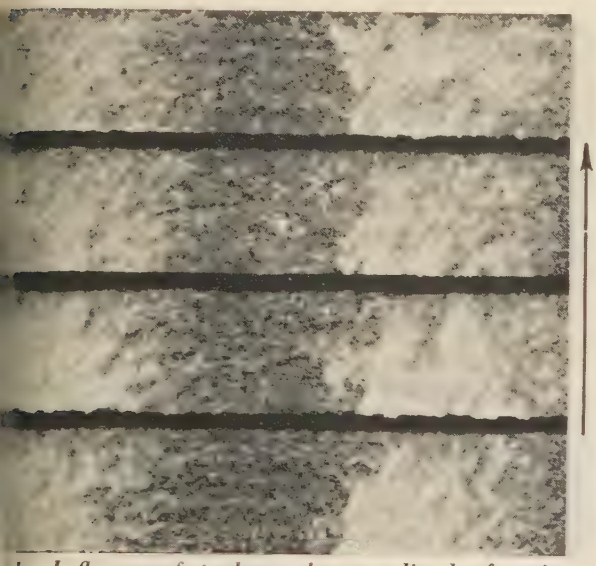
If the velocity of the stock leaving the slice greatly from the wire speed, the wire exerts a hi which accelerates (or decelerates as the case n the stock to the speed of the wire. On a hor wire the stock will assume the speed of the wire certain time, or distance traveled. In the mea number of layers have been deposited under varying drag. The drag definitely affects the fi entation. At the bottom layers the fibers will be oriented in machine direction with decreasing of orientation toward the top. Such operation machine would definitely contribute to the two ness of the sheet. For papers requiring unidire properties, like twisting papers, a high degree orientation is desirable, and here the effecti could be maintained over the forming length of t by sloping it up.

The acceleration of the stock taking place machine wire is illustrated in Fig. 12. A strip o produced with no shake has been disintegrated ing off a number of strips of adhesive tape plac time at exactly the same spot. The first strip (layer) shows very good formation. On the four lengthy conglomerates appear with gradually di ing length (strips No. 6 and 7) and toward the to sheet (11 strip) they appear as perfect flocs example shows that at the bottom layer the d been sufficient to pull the fibers out of the flocs a

-formed layer has resulted. Later, the drag only
hens the flocs and finally the flocs are deposited
tered. The formation of this paper was very bad
Fig. 10).

ing Board

forming board apparently improves the sheet



1. Influence of stock speed on amplitude of waviness

e speed and shake conditions constant. Stock speed
r than wire speed and increasing in direction of arrow.

tion. This influence could be expected for several
ns.
ie stock remains on the wire and has time to assume
peed of the wire, or at least approach it to a certain
t. This action increases the effectiveness of the
e by reducing the relative speed component in
ine direction, and so improves the formation and
ibly makes the sheet "squarer."
me is given for the shake to affect the condition of
tock prior to dewatering, but if there is a tendency
eculate, this action will have an adverse effect on
ation.
y irregularities in the flow of stock leaving the
can be smoothed out. This is particularly im-
nt in the high-speed machines where an even
ach flow is necessary in order to obtain good
tion and eliminate variations in caliper across the
ine.

age Characteristics of the Machine Wire

e amount of water removed at the table rolls
ding to the measurements carried out by A. A.
(*8*) and confirmed by various subsequent investi-
s, decreases rapidly as the stock moves along the
ine. This drainage characteristic is responsible
ie rapidly decreasing thickness of layers deposited
ch roll. It extends the area in which the top
n of the sheet is formed into the region where
hake intensity is markedly decreased and so the
ess practically disappears. In this region the
assumes the speed of the wire and any existing
re deposited without beneficial action of the drag.
se the drag is absent the fibers are now orientated
esser degree than the bottom part of the sheet.

These factors contribute greatly to the two-sidedness of the sheet and from this point of view appear to be undesirable.

At high machine speeds the quantity of water extracted at the first few table rolls is so great and all the disadvantages mentioned above so marked that experience has forced machine designers to reduce the rate of drainage at the beginning of the table by applying some corrective measures such as grooved table rolls or forming boards.

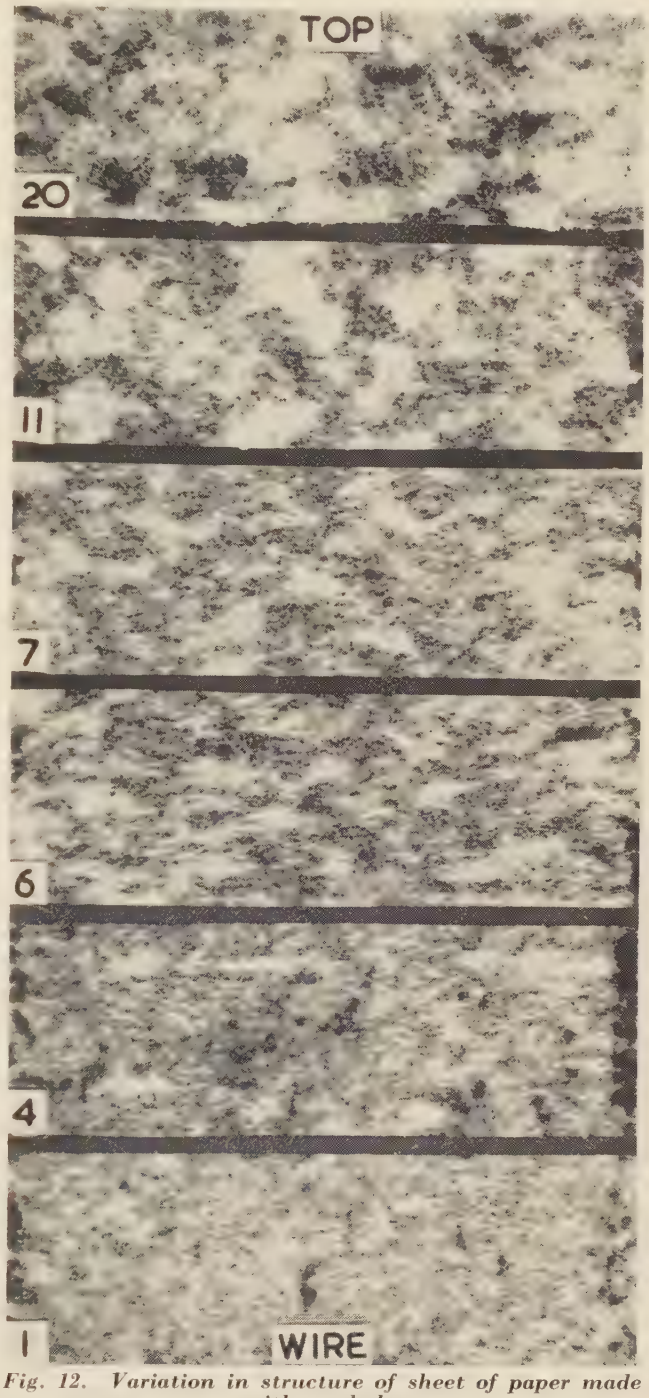


Fig. 12. Variation in structure of sheet of paper made with no shake

INFLUENCE OF STRUCTURE ON SHEET PROPERTIES

Physical Properties

The structure of a sheet of paper is one of its char-

acteristics and therefore it must be reflected to a greater or lesser extent in most of its various properties. Although the strength properties of the final product are particularly important, other properties such as wet web strength and those resulting from two-sidedness must also be considered. The knowledge of the structure should also be applied to the studies of such problems as sticking to the press, picking, splicing, and coating. For example, it has been observed that the adhesion of polyethylene to the paper varies according to the direction of the pulling force.

However, at this stage of the investigations it is too early to make a statement about the relationship between the structure and the properties and about the extent to which they can be influenced.

Sampling

The structure of the sheet varies along one wavelength and differences in the properties can be expected. Therefore, the sampling for evaluation of the product should be such as to take these variations into account. Tests carried out on the paper illustrated in Fig. 11 have shown the ratio of tensile strength in machine direction to cross direction to be 1.34 for the well-formed strips and 1.6 for those with bad, cloudy formation. These figures are easily understandable as the well-formed strip, deposited throughout the whole sheet thickness under effective drag in cross direction should represent a "squarer" sheet than the badly formed strips deposited at times of no shake when the fibers are orientated only in the machine direction.

Two-Sidedness

It has been previously mentioned that the stock tends to assume the wire speed, the intensity of the shake decreases along the wire, and the drainage characteristics of the wire are rapidly falling. These factors cause the waviness to disappear, the thickness of the layers to diminish, and the fiber orientation to decrease toward the top of the sheet. From the point of view of operating conditions the two-sided character of the sheet structure appears to be unavoidable. Another factor contributing to the two-sidedness is that the fines are being washed out of the bottom layers. The two-sidedness and associated effects are not always the very important properties. The importance of two-sidedness lies in the fact that it reduces greatly the range in which the papermaker is able to adjust his paper to its ultimate use. By a suitable adjustment of operating variables, he can influence the properties of only a portion of the sheet and has no control over the top part.

Idealized Structure of the Sheet

In the ideal case the sheet of paper would be built up in layers of equal thickness and showing the preferred fiber orientation in each layer varying according to a wavelike curve. This degree of preferred fiber orientation and the waviness should be the same for each layer throughout the sheet. The shift in phase of the wavelike curve from layer to layer results in a certain kind of lamination.

The equal thickness of layers throughout the sheet appears to be a fundamental structural requirement and it should always be maintained. The othe structural features: degree of fiber orientation, tude of waviness, and type of lamination are co by initial condition of the stock, stock/wire spee and shake amplitude and frequency. Here th ness and associated lamination extend the r which the structure of the sheet can be altered a becomes a useful tool in the hands of a pape The various possible structures of the sheet definitely be reflected in its physical properti greater extent than is possible at present, followed by suitable treatment in the press a section, a sheet with optimum properties acco its ultimate use could be obtained.

This ideal structure of the sheet is not unreali by redesigning of the wet end it could be clos proached in practice.

CONCLUSION

The mechanism of sheet formation on a fou wire machine is governed by the drainage zone able and the effect of stock acceleration and fiber orientation. As a result the sheet struct the following characteristics:

1. It is formed in layers whose thickness i mined by the quantity of water removed in th age zones.

2. It is three dimensional in character. Be acceleration downwards in the drainage zones th are deposited with a certain vertical component

3. It has a waviness of structure determi the shake condition. This becomes less distinct the top of the sheet because shake intensity d along the wire.

4. It has a type of lamination characterize difference in phase between the waves in the layers determined by the shake frequency, wir and table roll spacing.

Because the effects of factors governing th formation vary along the forming length of the w two-sided character of structure of paper as p on standard design paper machines is unavoidab

The internal structure of papers and boards revealed by the technique based on pulling off c tape from the sheet.

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Received Feb. 1, 1954.

This work was carried out as part of the Research program of Paper Manufacturers Ltd. whose permission to publish this pape fully acknowledged. Acknowledgment is made to associates in Paper Manufacturers for assistance in this work, particularly G. E son who first demonstrated the cellulose tape technique and C. T the photography.

ASSOCIATION NEWS AND EVENTS

ɔcal Section Meetings

Pacific: May 20–22, 1954, Gearhart Hotel, Gearhart, Ore. nual Meeting.

Delaware Valley: May 27, 1954, Engineers Club, Philaphia, Pa. Edward J. Albert Award Competition.

New England: June 11–12, 1954, Oceanside House, gnolia, Mass. Annual Meeting. Oct. 8–9, 1954, Berke Inn, Great Barrington, Mass.

Empire State: June 10–13, 1954, Whiteface Inn, Lake id. N. Y.

Empire State Central District: June 4, 1954, University b. Syracuse, N. Y. Annual Meeting.

Empire State Eastern District: June 20, 1954, Glens Falls, Y. Annual Meeting.

Maine-New Hampshire: June 18-19, 1954, Marshall se, York Harbor, Me. "Recent Advances in Pulping hniques."

Chicago: May 17, 1954, Chicago Bar Association Rooms, cago, Ill.

Lake Erie: May 19–20, 1954, Hotel Carter, Cleveland, o.

Southeastern: May 14–15, 1954, De Soto Hotel, Savannah,

PPA Technical Section, June 14–17, 1954, Empress el, Victoria, B. C. Summer Meeting.

n. Pulp & Paper Mill Superintendents Association, June 3. 1954, Sheraton-Mount Royal Hotel, Montreal, P. Q. nal Meeting.

aine-New Hampshire

he annual meeting of the Maine-New Hampshire Section be held at the Marshall House, York Harbor, Me., on e 18–19, 1954.

A social program will be conducted on the evening of June or early arrivals. J. Fife Wright of the National Aniline ision, H. E. Pratt, Pejepscot Paper Co., and Joseph J. mas, S. D. Warren Co., are the members of the local ngements committee.

Registration will take place from 10 a.m. to 2 p.m. on ay, June 18. At 11 a.m. the annual meeting of the ion will be held at which the new officers and three mem- of the executive committee will be elected. The nominat- committee consists of Clifford Patch, Eastern Corp., Jemus, University of Maine, and J. F. Wright, National ne Division.

E. Jones, Oxford Paper Co., is chairman of the technical ram committee. Associated with him is F. N. Sprague, Regis Paper Co., Roland Martin, Fraser Paper Co., and y S. Hooper, Penobscot Chemical Fibre Co.

he following papers will be presented:

"Pulpwood Resources of Northern New England," by Victor S. Jensen, Manager of the White Pine, Hardwood Research Center of the U. S. Forest Service.

"Recent Developments in Masking Pulp Mill Malodors," by Breckenridge K. Tremaine, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

"Recovery of Ammonia by Simultaneous Evaporation of Acid and Alkaline Waste Liquors and Reuse of It in Pulping," by Lyle C. Jenness, University of Maine, Orono, Me.

"Semichemical Pulping with Caustic Soda," by R. J. P. Keswick, Bathurst Power & Paper Co., Ltd., Bathurst, N. B.

In the evening there will be a banquet followed by a few short talks.

In the afternoon there will be a ladies bridge tournament and tea. Mrs. J. J. Thomas and Mrs. A. E. Jones are the members of the ladies committee.

Saturday will begin with the "TAPPI Breakfast with Bart" under the direction of the rise and shine committee, Bart Taylor, chairman.

The technical program on Saturday morning will be a panel discussion on "Recent Advances in Pulping Technique."

A tour of the old houses of Portsmouth, N. H., has been arranged for the ladies.

At noon there will be the famous New England clambake on the shore followed by a program of golf, sailing, swimming, and rocking chairs. Walter Wentworth, Clinton Foods, Inc., and J. H. Heuer, Great Northern Paper Co., will have charge of the golf tournament and F. A. Strovink, American Cyanamid Co., will be in charge of the fishing tournament. Prizes will be awarded at the sports dinner held on Saturday evening.

Room reservations should be made with the Marshall House, York Harbor, Me.

Empire State

The annual meeting of the Empire State Section will be held at Whiteface Inn, Lake Placid, N. Y., on June 10–12, 1954.

The technical papers to be presented include the following:

"The Hurletron Caliper Control System."
"The Rotabelt."
"Odor Control in Board for Food Packaging."
"Flotation Deinking."
"The Application of Polyethylene and Polyethylene-Wax Blends by Extrusion and Roller Coating Methods."
"Modification of Plastic Fibers for Specific Packaging Needs."
"New Chemical Products of Interest to the Paper Industry."
"Symposium on Stream Improvement."

Reservations should be made with Henry W. Haynes, Whiteface Inn, Whiteface, N. Y. The inn is located $2^1/_2$ miles from Lake Placid Village.

Fibrous Agricultural Residues Conference

The Eleventh TAPPI Fibrous Agricultural Residues Conference will be held at the Northern Regional Research Laboratory, Peoria, Ill., on Nov. 8–9, 1954.

Pulp Testing Committee

The executive committee of the TAPPI Pacific Section recently voted to sponsor the TAPPI Pulp Testing Committee. Frank E. Caskey of the Crown Zellerbach Corp., Camas, Wash., is chairman of the committee. The Section is also sponsoring the TAPPI Acid Pulping Committee. Sponsoring of an Association committee involves special interest on the part of a Section in assisting a committee in performing its major functions, of which provision for frequent meetings is of prime importance. The Pacific Section has performed an important service to the Association in encouraging the work of the Acid Pulping Committee.

Ninth Engineering Conference

The Ninth Engineering Conference of the Technical Association of the Pulp and Paper Industry will be held at

the Benjamin Franklin Hotel in Philadelphia, Pa., on Oct. 18–21, 1954.

Following is the plan of the meeting:

October 18, 1954

8:00 a.m.	Registration (Mezzanine)
9:15 a.m.	Mill Planning and Economics (Crystal Room)
10:45 a.m.	Steam and Power (Crystal Room)
12:30 p.m.	Committee Luncheons
	Electrical Engineering (Room 206)
	Materials Handling and Industrial Engineering (Room 244)
	Engineering Research and Machine Design (Room 252)
	Mill Maintenance and Materials (Room 210)
2:00 p.m.	Chemical Engineering (Crystal Room)
3:45 p.m.	Discussion Meetings
	Chemical Engineering (Crystal Room)
	Mill Planning and Economics (Crystal Room Foyer)
	Steam and Power (Betsy Ross Room)

October, 19, 1954

9:00 a.m.	Electrical Engineering (Crystal Room)
10:30 a.m.	Materials Handling and Industrial Engineering (Crystal Room)
12:30 p.m.	Committee Luncheons
	Mill Planning and Economics (Room 230)
	Steam and Power (Room 252)
	Chemical Engineering (Room 206)
	Drying and Ventilating (Room 210)
	Hydraulics (Room 244)
2:00 p.m.	Engineering Research and Machine Design (Crystal Room)
3:45 p.m.	Discussion Meetings
	Engineering Research and Machine Design (Crystal Room)
	Electrical Engineering (Betsy Ross Room)
	Materials Handling and Industrial Engineering (Crystal Room Foyer)
	Data Sheets (Independence Room)
6:00 p.m.	Social Hour (Franklin and Betsy Ross Rooms)
7:30 p.m.	Dinner (Crystal Room)

October, 20, 1954

9:00 a.m.	Mill Maintenance and Materials (Crystal Room)
10:30 a.m.	Drying and Ventilating (Crystal Room)
12:30 p.m.	Engineering Division Luncheon (Crystal Room)
2:30 p.m.	Hydraulics (Betsy Ross Room)
3:30 p.m.	Discussion Meetings
	Hydraulics (Betsy Ross Room)
	Mill Maintenance and Materials (Franklin Room)
	Drying and Ventilating (Crystal Room Foyer)

October 21, 1954

Plant visits to be announced.

Lehigh University Luncheon Group

The alumni of Lehigh University connected with the pulp and paper industry are planning a luncheon to be held during 1955 Paper Week (Feb. 20–25, 1955) in New York.

All members of the Lehigh University alumni are urged to send their names, addresses, and company affiliations to Norman Alper, Norman Alper & Co., 188 Main St., Pawtucket, R. I., Walter S. Miller, Gulf Oil Corp., Gulf Bldg., Pittsburgh, Pa., or to Harry C. Martin, The Brown Paper Mill Co., Monroe, La., so that notices regarding the time and place of the luncheon can be sent to them prior to the TAPPI Annual Meeting.

M.I.T. Luncheon Group

At the alumni luncheon of the Massachusetts Insti Technology held in February, Paul J. Shirley of Pe Ford, Ltd., Inc., New York, N. Y., was elected chair the alumni group, succeeding Henry S. Dimmick Industries, Philadelphia, Pa. The next luncheon held in the South Room of the Commodore Hotel, Nev N. Y., on Wednesday, Feb. 23, 1955. The surplus of obtained from the February luncheon was contributed M.I.T. Alumni Fund.

Brooklyn Polytechnic Summer Cou

The Polytechnic Institute of Brooklyn will give Summer laboratory courses for the benefit of individua nected with industrial companies who wish to be brou in the most modern techniques. Attendance at each courses is limited to insure intensive individual attenti contacts between instructors and participants.

"Progress in Polymerization and Copolymerization niques," June 28 to July 2, 1954. Professors H. F and C. G. Overburger and Instructors R. B. Mesrob Morawetz, and G. Oster. (Fee $125.)

"Properties of Macramolecules in Solution, Includin electrolytes and Other Water Soluble Polymus." Ju July 16, 1954. Professors F. R. Eirich and H. Moraw Instructors P. M. Doty, P. H. Frank, E. Immer Loebel, H. Mark, R. B. Mesrobian, and G. Oste $125.)

"Industrial Application of X-Ray Diffraction." Prof Faukerchen, Instructors Margot E. Bergmann, Boris kin, Benjamin Post, and Ephrairn Segerman. (Fe Address all inquiries to Mrs. Doris Cattell, Secretary mer Laboratory Courses, Polytechnic Institute of Br 99 Livingston St., Brooklyn 1, N. Y.

LETTERS TO THE EDIT

Industry Note

To the Editor, *Tappi:*

May we call to your attention the fact that on pag of the March, 1954, issue of *Tappi*, there appeared graph concerning this firm which was entirely misleas

Under date of December 31, we sent you a notifica the Association with this firm of Messrs. David Myers and Michael Pope. In transcribing that m publication, a sentence was omitted which specific ferred to association with this firm of Messrs. Myers an The sentence referred to should have preceded the l tence of the notice. In other words, the last section note should have read as follows:

The Association of Messrs. David Moffat Myers a chael Pope with Seelye Stevenson Value & Knecht en to offer pulp and paper firms the benefit of many y concentrated experience in the steam and power fie partners in the now dissolved firm of Myers and Ad these men assisted such companies as the Union Paper Corp., the Camp Manufacturing Co., the Board and Carton Co. in the development of eco utility systems.

In order that there may be no confusion regardi organization, may we request that the notice be c as indicated.

A. Wilson Knecht
Seelye Stevenson Value &
New York, N. Y.

NOTICE

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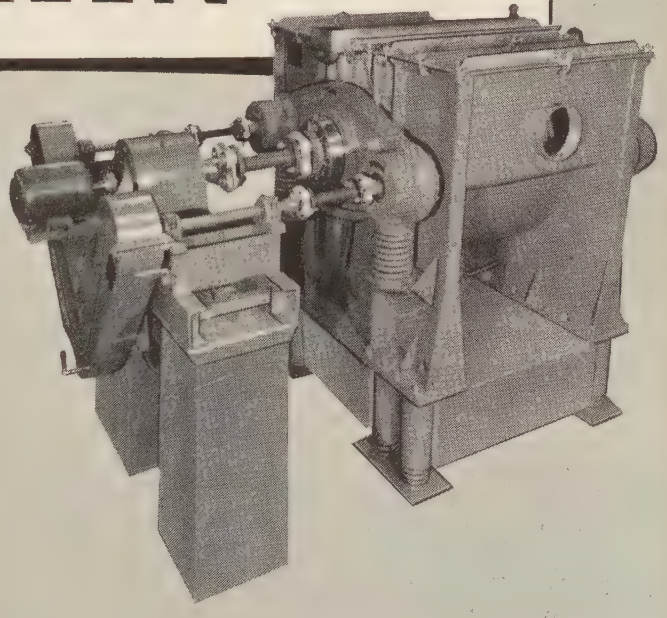

The record of Vibrotor Screen performance in this country and abroad amply justifies the statement that this rotary slotted plate Screen rates *first consideration* for screening of sulphate and sulphite pulps, in double dilution systems, on defibratored stocks, on deinked stocks and on high density paper stocks.

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Harold A. Arbit, Chemical Engineer, Bakelite Co., Bound Brook, N. J., a 1952 graduate of Northeastern University.

Philip R. Askman, Engineer, Chas. T. Main, Inc., Boston, Mass., a 1944 graduate of Lafayette College.

Richard J. Auchter, Superintendent, Pulp Laboratory, Kimberly-Clark Corp., Neenah, Wis., a 1935 graduate of Marquette University.

Herbert I. Bernstein, Technical Director, The Kadiman Chemical Corp., Haifa, Israel, a 1940 graduate of Pennsylvania State College with a Ph.D. degree.

Joseph H. Bertram, President and Treasurer, Joseph H. Bertram & Co., Inc., Brookline, Mass., a 1937 graduate of Pennsylvania State College.

Raymond M. Bishop, Manager, Paper Chemicals Sales and Service, Hercules Powder Co. (Canada) Ltd., Burlington, Ont., Canada, a 1946 graduate of the University of Toronto.

Asbjorn Borgesen, Technical Manager, Mathiesen-Eidsvold Vaerk., Bon, Norway, a 1923 graduate of Norges Technical University.

Lawrence M. Burns, Manager, Pulp Div., Brown Co., Berlin, N. H., a 1933 graduate of Colby College.

Jack M. Calkins, Sales Representative, Frontier Chemical Co., Wichita, Kan., a 1949 graduate of Baylor University.

Claude Cantin, Chief Chemist, St. Lawrence Corp. Ltd., East Angus, P. Q., Canada, a 1951 graduate of McGill University.

Charles V. Caressi, Chief Chemist, Empire Box Corp., Stroudsburg, Pa., a 1950 graduate of Wagner College.

Edmund T. Charnock, Superintendent, Technical Service Dept., The Great Lakes Paper Co. Ltd., Fort William, Ont., Canada, a 1938 graduate of the University of Toronto.

Glen A. Christensen, Chemical Engineer, Rayonier, Inc., Hoquiam, Wash., a 1950 graduate of Oregon State College.

Byron B. Coulter, Chemist, New London Mills, Inc., New London, Conn. Attended the University of Kentucky.

Joseph F. Cronin, Sales Agent, Cheney Bigelow Wire Works, Springfield, Mass., and Tyer Rubber Co., Andover, Mass.

Amable C. Cueto, President, Cartonajes Estrella, S. A., Mexico, D. F., Mexico.

Alan K. Davidson, Quality Control Engineer, The Buckeye Cellulose Corp., Foley, Fla., a 1951 graduate of the University of Alabama.

Frank L. Dicks, Partner, C. O. Dicks Co., Plainfield, N. J.

Jan A. Dokoupil, Paper Chemist, Dixie Cup Co., Easton, Pa., a 1948 graduate of Technical University of Dr. Ed. Benes, Brno, Czechoslovakia.

Eugene Doubs, Manager and Service Engineer, Combustion Engineering Ltd., Sao Paulo, Brazil, a 1925 graduate of the Technical University.

Robert C. Dressler, Chemist, Thilmany Pulp & Paper Co., Kaukauna, Wis., a 1948 graduate of Washington University.

Sidney M. Edelstein, President and Technical Director, Dexter Chemical Corp., New York, N. Y., a 1932 graduate of Massachusetts Institute of Technology.

Charles L. Felner, Chemical Supervisor, The Buckeye Cellulose Corp., Foley, Fla., a 1949 graduate of Georgia Institute of Technology.

George C. Fewson, Technical Director, Superior Wood Products, Inc., Duluth, Minn., a 1942 graduate of the University of Iowa.

Albert H. French, Senior Chemist, Congoleum Nair Kearny, N. J., a 1925 graduate of the University of P vania.

Harry Goldberg, Sales Engineer, Samuel M. Langst Camden, N. J.

Adie D. Harbin, Jr., Chemist, Diamond Alkali Co., ville, Ohio, a 1937 graduate of the University of Chatt

Jerrold G. Hedin, Service Engineer, The Glidde Des Plaines, Ill., a 1946 graduate of Purdue University

Gardner P. Heller, Technical Supervisor of Convertin ucts, Albemarle Paper Mfg. Co., Richmond, Va., graduate of Virginia Military Institute.

Wayne G. Henderson, Superintendent, Engineeri Loss Control Div., Travelers Insurance Co., Hartford, a 1923 graduate of the University of Michigan, Co Engineering.

Warren E. Hesler, Chemical Engineer, Swenson Eva Co., Harvey, Ill., a 1947 graduate of Northeastern Uni

Kenneth Heuck, Branch Manager, Interchemical Printing Ink Div., Cincinnati, Ohio, a 1942 graduate University of Cincinnati.

Robert G. Jahn, Coatings Research and Developmer neer, Dow Chemical Co., Midland, Mich., a 1948 g of Bay City Junior College.

Jack F. Kilborn, Chemical Engineer, Internationa Co., Mobile, Ala., a 1948 graduate of Alabama Po Institute.

Herbert K. Kingsbury, Sr., Application Engineer Chalmers Mfg. Co., Norwood, Ohio, a 1943 graduate quette University.

Philip G. Kinken, Assistant General Superint Pulp Mills, Champion Paper & Fibre Co., Canton, N 1934 graduate of North Carolina State College.

William F. Kruschka, Plant Engineer, Clifton Pape Co., Clifton, N. J.

Michel J. Lessard, Mill Chemist, International Board Ltd., Gatineau, P. Q., Canada, a 1951 grad Queen's University.

Immanuel Lichtenstein, Design Engineer, Structura Co., New York, N. Y., a 1942 graduate of Columbia sity School of Engineering, and a 1952 graduate of Institute of Technology.

Robert F. Link, Technical Representative, A. E. Co., Decatur, Ill., a 1953 graduate of the University of Engineering College.

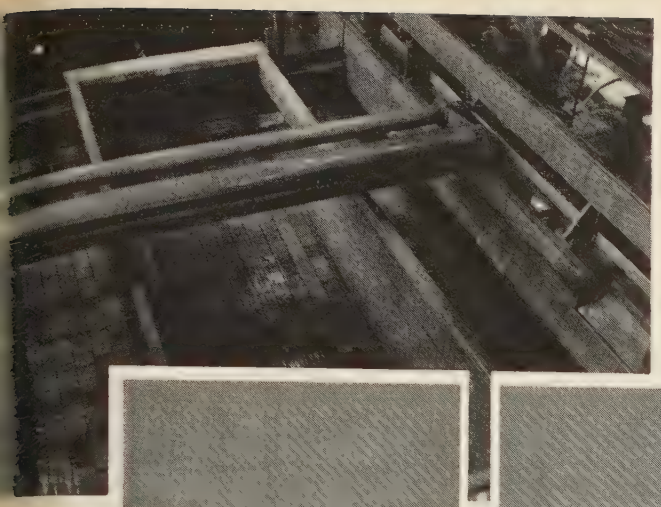
Leonard H. Lipman, Assistant Manager, Corrugating Stein-Hall & Co., Inc., New York, N. Y., a 1925 grad the University of Maryland.

James B. Lockhart, Jr., Upper Mills Manager, Paper Corp., Riegelsville, N. J., a 1940 graduate University.

William Louden, Director of Product Develo Paterson Parchment Paper Co., Bristol, Pa., a 1943 g of Massachusetts Institute of Technology.

William D. Major, Student, Institute of Paper Che Appleton, Wis., a 1953 graduate of Colgate University.

Milton Markman, Quality Control Coordinator, Schweitzer, Inc., Spotwood, N. J., a 1938 graduate of t



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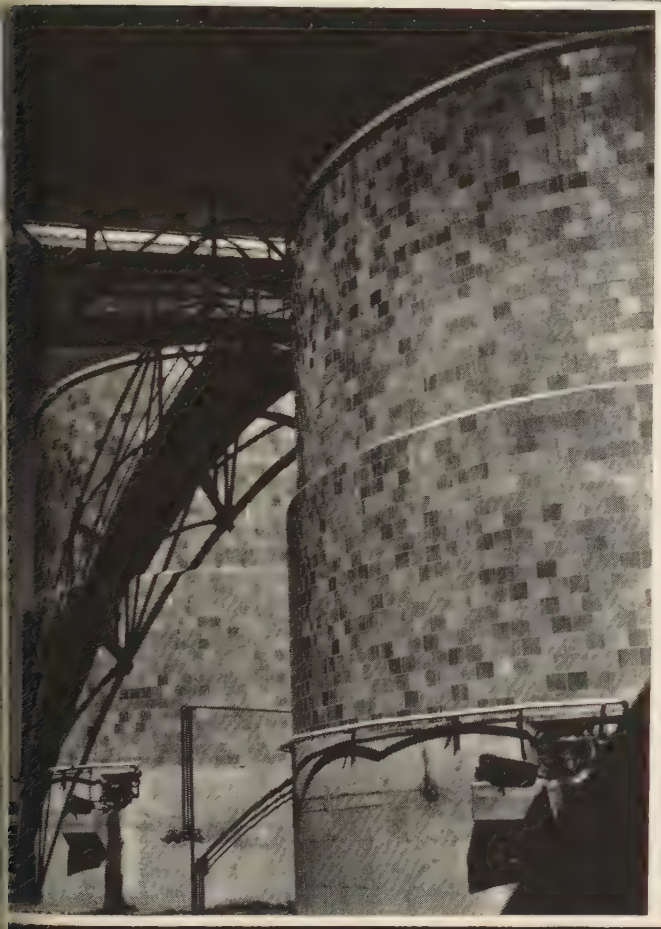

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versity of Louisville, and a 1941 graduate of the New York State College of Forestry.

Gordon M. Moulds, Instructor, State University of New York, College of Forestry, Syracuse, N. Y., a 1953 graduate of McGill University with a Ph.D. degree.

Hallard C. Moyer, Senior Project Engineer, Sinclair Research Laboratories, Inc., Harvey, Ill., a 1940 graduate of the University of Nebraska.

Homer H. Mullins, Assistant Plant Engineer, The Brown Paper Mill Co., Inc., Monroe, La. Attended the University of Alabama.

John H. Murphy, Adhesive Service Engineer, Philadelphia Quartz Co., Philadelphia, Pa., a 1948 graduate of Massachusetts Institute of Technology.

Sam L. Neidorf, Vice-President and General Manager, Empire Box Corp. of Stroudsburg, Stroudsburg, Pa. Attended Northwestern University.

Eugene L. Niederhofer, Project Engineer, Chemical Plants Div., Blaw-Knox Co., Pittsburgh, Pa., a 1924 graduate of Armour Institute of Technology.

Francisco J. Olavarriets, Technical Supervisor, Cia. de les Fabrica de Papel San Rafael, Mexico City, Mexico, a 1948 graduate of the National University of Mexico.

Doo Har Park, Student, Massachusetts Institute of Technology, Cambridge, Mass.

John D. Peel, Forest Chemist, Federation of Malaya. Forest Dept., Kuala, Lumpur, Malaya, a 1948 graduate of the University of Liverpool.

Robert E. Purcell, Technical Representative, Alkali Div., Westvaco Chemical Dept., Food Machinery & Chemical Corp., New York, N. Y., a 1950 graduate of Purdue University.

Clyde A. Reaves, Assistant Chemical Engineer, Gulf States Paper Study, Tuscaloosa, Ala., a 1948 graduate of Georgia Institute of Technology.

Fred L. Riley, Chemist, Brown Co., Berlin, N. H., a 1939 graduate of Bates College.

William X. Robinson, Sales Representative, John D. Robinson Co., Savannah, Ga.

Albert C. Rolfe, Manager, Technical Service Dept., Imperial Chemical Industries Ltd., Alkali Div., Winnington, Northwich, Cheshire, England, a 1934 graduate of Trinity College, Oxford.

Hans Sadler, Head, Dept. of Pulp and Paper Technology, Polytechnic University, Vienna, Austria, a 1925 graduate of the Technical University with a Ph.D. degree.

Jean Savard, Chief of Chemical Dept., Tropical Forestry Technical Center, Nogent sur Marne, France, a graduate of the University of Lille with a D.Sc. degree.

Robert F. Searle, Vice-President in Charge of Manufacturing, Arkell & Smiths, Canajoharie, N. Y., a 1941 graduate of the United States Naval Academy.

Edward B. Seeger, Sales Manager, Samuel M. Langston Co., Camden, N. J.

Horace L. Smith, Jr., Consulting Engineer, Richmond, Va., a 1915 graduate of Virginia Military Institute.

Robert C. Sonntag, Chemist, National Lead Co., Philadelphia, Pa., a 1948 graduate of Pratt Institute.

Walter H. Stauffenberg, Salesman, American Cyanamid Co., New York, N. Y., a 1949 graduate of Pennsylvania State College.

Edgar L. Stentz, Plant Engineer, Ohio Boxboard Co., Rittman, Ohio, a 1933 graduate of Carnegie Institute of Technology.

Thad G. Stevens, Chief Engineer, General Insurance Co. of America, Seattle, Wash. Attended Massachusetts Institute of Technology.

Henry R. Suarez, General Manager, Papelera Rio Verde, S. A., Havana Prov., Cuba, a 1941 graduate of the University of Missouri.

R. Casper Swaney, Manager, Mountain State Fabricating Co., Clarksburg, W. Va., a 1931 graduate of Geneva College.

William H. Taylor, Sales Representative, Allis-Ch Mfg. Co., Philadelphia, Pa., a 1942 graduate of Drexe tute of Technology.

Erich P. Tilenius, President, Tilenius & Randolp Toledo, Ohio.

Charles P. Trosch, President, General Manager, Sale ager, Paper Converting & Finishing Co., Chicago, Ill.

Sergio Vadillo, Assistant General Superintendent, las Fabricas de Papel de San Rafael, Mexico City, Me 1943 graduate of the National University of Mexico.

Camille F. Vozar, Plant Manager, Paper Conver Finishing Co., Chicago, Ill. Attended Illinois Insti Technology.

Vernon E. Weis, Laboratory Foreman, Buckeye C Corp., Foley, Fla., a 1948 graduate of Washington Univ

James P. Weldon, Technician, J. D. Cahill Co., Ha Mass., a 1952 graduate of Holy Cross College.

Evan W. Williams, General Manager, Industrial Products Manufacture, Grain Products, Inc., Dodg Kan. Attended Lawrence College.

Quincy J. Winsor, Manager, Development Sale Thew Shovel Co., Lorain, Ohio, a 1916 graduate o Institute of Technology.

Max T. Wuppermann, Manager, Eberfelder Papie G.m.b.H., Wuppertal-Elberfeld, Germany, a graduate Technical University.

Richard W. Young, Sales Engineer, Combustion En ing, Inc., Cincinnati, Ohio, a 1947 graduate of Cornell sity.

John W. Zimmerman, Division Manager, The Cha Paper & Fibre Co., Hamilton, Ohio. Attended Wash and Lee University.

TAPPI Notes

Derry Akeroyd is now Production Manager of the P Products Corp., Milltown, N. J.

Oscar E. Anderson, formerly Assistant Manager of t Mill at Livermore Falls, Me., has been transferred York City to head the new sales and manufacturing department of the International Paper Co.

Fred B. Attwood, formerly Vice-President of W. C & Co., is now with the River Raisin Paper Co., Monroe

Albert E. Bachmann is now Vice-President of the St Packaging Co. and Executive Vice-President of the quoi Corp.

Burt E. Bates is now Chief Planner for the Gair C Div., Robert Gair Co., Piermont, N. Y.

Howard Bidwell, formerly of Brightwater Paper Co., Master Mechanic for the Parsons Paper Co., Holyoke

Walter J. Cassidy, formerly of the Sorg Paper Co., Manager of the Technical Paper Div., Whiting Pap Holyoke, Mass.

C. Duane Coates, formerly of the Army, is now Cl Engineer for the Mead Corp., Chillicothe, Ohio.

R. C. Crain, formerly General Superintendent of the bia River Paper Mills, is now Director of Research a velopment for the Rhinelander Paper Co., Rhinelande

William M. Ebersole is now Manager of Production Macon Kraft Co., Macon, Ga.

Robert R. Edwards, Vice-President and Manager of facturing of Pacific Mills, Ltd., has transferred his offi Ocean Falls, B. C., to Vancouver, B. C.

C. Westcott Gallup, Jr., formerly of R. T. Vanderb is now with F. C. Huyck & Sons, Rensselaer, N. Y.

P. H. Glatfelter is now Chairman of the Board of Glatfelter Co., Spring Grove, Pa.

Philip H. Glatfelter III is now President and Treas P. H. Glatfelter Co., Spring Grove, Pa.

John A. Gregg, formerly of S. Curtis & Son, is now I of Quality Control of the Empire Box Co., Garfield, N.

Dependable Source for Chemical Raw Materials

Richard T. Trelfa (left), technical director, discusses test results with H. S. Faram, quality control manager, Watervliet Paper Company, Watervliet, Michigan

"Over the years, we've found Wyandotte Chemicals an excellent source of supply"

—R. T. Trelfa, Watervliet Paper Company

:permaking is a two-phase job. ou have to produce a top-quality ock, within practical bounds of st. to insure saleability. And, ually important, you must be on e lookout for new ideas and thods to keep pace with progress. The operations of the Water-iet Paper Company, Watervliet, ichigan, are a good example of dern papermaking efficiency. ality is controlled every step of e way. This, of course, includes e quality of materials purchased, e Wyandotte Caustic and Chlo-e. They use caustic in treating ste paper; chlorine is needed in ipmaking and bacteria control. With an eye to the future, Water-et has established the country's st mill to produce a fully bleach-neutral sulphite, semi-chemical pulp from hardwood. Furthermore, they have pursued an active course of co-operation with Wyandotte's research. Some of the joint activities have been detailed engineering on soda-based hypochlorites, and the application of fine calcium carbonates to paper finishes.

Commenting on Wyandotte products and service, R. T. Trelfa, Watervliet's technical director, says, "Over the years, we've found Wyandotte an excellent source of supply from the standpoint of both product quality and dependability of service."

If you use alkalies, chlorine, wetting agents, solvents, fumigants, insecticides or other chemicals, contact Wyandotte for either product data or technical service. You will find Wyandotte large enough to care for your needs, yet not too large to be interested in your day-to-day problems. Tell us your requirements . . . we may have a chemical that will satisfy your needs, or will work with you in developing a new one. May we serve you. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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Calcium Carbonate • Calcium Chloride • Glycols • Synthetic Detergents • Agricultural Insecticides • Soil Conditioners
Other Organic and Inorganic Chemicals

William E. Hamilton, Technical Service Engineer of the Hercules Powder Co., has been transferred from Holyoke, Mass., to New Orleans, La.

George E. Hall was reported in this column in the March issue of *Tappi* to have left the Wyandotte Chemical Corp. and joined the Bristol Co. This report was an error. Another gentleman by the name of G. A. Hall was recently designated official representative in TAPPI by the Bristol Co. of Waterbury, Conn.

Robert E. Harper is now Director of Purchases for the Rhinelander Paper Co., Rhinelander, Wis.

Morris W. Hedden, Potsdam, N. Y., is no longer with the Racquette River Paper Co.

Parker B. Holden, formerly of the Stowe-Woodward Co., is now with the Tyer Rubber Co., Andover, Mass.

George N. Hoover, Jr. is now Resident Manager of the West Virginia Pulp & Paper Co. mill at Mechanicville, N. Y.

Donald T. Jackson is now Technical Director of the Hammermill Paper Co., Erie, Pa.

George E. Jackson, formerly Assistant Superintendent of Rayonier, Inc. is now with Bowaters Southern Paper Corp., Calhoun, Tenn.

Leslie G. Janett is now Vice-President and Manager of the J. O. Ross Engineering Corp., Chicago, Ill.

Frankin L. Jones, formerly of the St. Joe Paper Co., is now Paper Mill Superintendent of the Container Corp. of America, Fernandina Beach, Fla.

H. Lawrence Ketcham, Jr., formerly of DuPont, is now Chemist for the Southern Chemical Cotton Co., Chattanooga, Tenn.

George V. Knapp is now Manager of Engineering Practices for the General Electric Co., Schenectady N. Y.

David B. Laird, formerly of the Borden Co., is now Chemist for the Scintilla Div. of Bendix Aviation Corp., Sidney, N. Y.

Donald E. Lawson of Rayonier, Inc. has been transferred from Port Angeles, Wash., to Fernandina Beach, Fla., as Assistant Resident Manager.

Joseph T. Loomer is now Assistant Technical Director of the Folding Board Div., Robert Gair Co., Uncasville, Conn.

Frank Makara, Chairman of the TAPPI Patents Committee has opened his own private office as a registered patent attorney in Room 3208, Woolworth Bldg., 233 Broadway, New York 7, N. Y.

John J. McInnis, formerly of the Quebec North Shore Paper Co., is now with Bowaters Southern Paper Corp., Calhoun, Tenn.

Sam C. McKee, formerly student at The Institute of Paper Chemistry, is now a Junior Research Chemist for the Weyerhaeuser Timber Co.. Longview, Wash.

William R. McNally of the Link-Belt Co. has been transferred from Chicago, Ill., to Pittsburgh, Pa.

Charles J. Meloun is now Manager of the Paper and Textile Engineering Dept. of the General Electric Co., Schenectady, N. Y.

Frederick P. Moden, formerly of the Anglo-Canadian Pulp and Paper Co., is now Assistant Paper Mill Superintendent for Bowaters Southern Paper Corp., Calhoun, Tenn.

George O. Nelson, formerly of the Puget Sound Pulp & Timber Co., is now Sulphite Superintendent of the Ketchikan Pulp Co., Ketchikan, Alaska.

Newton L. Nourse is now Vice-President in Charge of Sales for the Brown Co., Boston, Mass.

Richard C. Peterson, formerly of the Riegel Paper Corp., is now Technical Director of the Bergstrom Paper Co., Neenah, Wis.

George W. Reynolds, formerly of the Macon Kraft Co., is now Plant Engineer for the Rome Kraft Co., Rome, Ga.

Samuel Richardson, formerly of the Great Lakes Paper Co., Ltd., is now Assistant Technical Service Superintendent for Bowaters Southern Paper Corp., Calhoun, Tenn.

S. Bertil Segring, formerly Manager of Holmens B Fabriks A/B, is now Engineer for Projecting A/B, Stoc Sweden.

Howard K. Sheldon is now Superintendent of Nitro for the Liberty Powder Co., Baraboo, Wis.

Eleanor G. Sheridan, formerly of the U. S. Finis Mfg. Co., is now Chemist for Calresin Corp., Los A Calif.

Daniel T. Snell of the Robert Gair Co., Inc., has beer ferred from Bogota, N. J., to Uncasville, Conn., as Ch Engineer.

Lazarus Spievak, formerly of the Snyder Chemical C now Plastics Engineer for the Rogers Corp., Goodyear,

Bjorn Sucksdorff is now Manager of the Technical I ment of Kymmene Paper Mills, Kuusaukoski, Finland

Joseph N. Swartz, formerly of the Howard Smith Mills, Ltd. is now Technical Service Superintendent waters Southern Paper Corp., Calhoun, Tenn.

Raymond H. Taylor, formerly of the Army, is now a m of the pulp and by-products group, Minnesota & Paper Co., Minneapolis, Minn.

Lawrence P. Thompson is now General Manager Paper Div. of Personal Products Corp., Milltown, N. J

John L. Vanderberg, formerly of R. T. Vanderbilt now in pulp sales for David A. Howard Co., Kalamazoo

Janis A. Vazdikis, formerly of the Central States En ing Co., Inc., is now Assistant Chief Engineer for th Virginia Pulp & Paper Co., Luke, Md.

Frederick B. Wardwell, formerly of the U. S. Mar now a Technical Sales Representative for the Brow Berlin, N. H.

Allan Wastvind, President of SF Products, Canada has moved his office from Montreal to Three Rivers, Qu

Frederick Wierk, formerly of the National Containe is now a Consulting Engineer in Jacksonville, Fla.

Alvin R. Wilson, formerly of the Hamilton Mfg. now Assistant Superintendent for the Riegel Paper Milford, N. J.

* * *

Gus Kuhlman, Production Manager, has been de official representative of Personal Products Corp., Mi N. J., in TAPPI, succeeding *R. A. Monteith.*

Harold S. Vanderhei, Vice-President in Charge of P tion has succeeded *Jermain B. Porter* as the official repr tive of the D. M. Bare Paper Co., Roaring Spring, Pa. Technical Association.

Pasquale Caretta has succeeded *Mario Morelli* as the representative of Cartiere Burgo, Torino, Italy, in TA

The name of Pacific Mills, Ltd., Ocean Falls, B. been changed to Crown Zellerbach Canada, Ltd.

* * *

Walter P. Murray, Sales Manager, has succeeded *Ames* as the official representative in TAPPI of the Hope Machinery Co., Taunton, Mass.

A. C. Embshoff has succeeded *E. L. Crowley* as the representative in the Technical Association of Infilc Tuscon, Ariz.

The Certified Pulp Testers Bureau, New York, N. approved the following individuals and companies for

A. B. Andrews, Box 57, Lewiston, Me.
Dauneker & Evans, Inc. 309 Camp St., New Orleans, La
J. T. Donald & Co., Ltd., 1181 Guy St., Montreal, P. Q
Neil C. Goodrich, South Haven Terminal Co., South Mich.
Gulick-Henderson Laboratories, 431 S. Dearborn St., 5, Ill.
L. Gutiernez-Vela, Felix Paquin & Associates, Ga Laboratories, Galveston, Tex.
Hamlin & Morrison, 216 S. 2nd St., Philadelphia, Pa.
William Landes, Paper and Pulp Testing Laboratories 28th St., New York, N. Y.

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You can also use "ELVANOL" for:

- Improved paper strength and surfaces ideal for gloss printing. Penetration of oil, ink or lacquer is held to a minimum.
- Grease-resistant paper and boxboards.
- Greaseproof drum linings.
- High strength, tear and erasure resistance for a wide variety of commercial papers—including bond, index and ledger.

Du Pont tests show that the completely hydrolyzed grades of "Elvanol" form excellent greaseproof coatings on paper which can be used for packaging butter, oleo, lard, nuts, doughnuts, cookies, bacon and sausage. "Elvanol" coatings also provide a protective barrier against air. In this way, "Elvanol" coatings give your food wrap papers the kind of protection that keeps customers satisfied.

You can also profit from many other advantages of "Elvanol." You get durable, flexible coatings that will take customary folds without cracking. You can increase coating flexibility, when needed, by using "Elvanol" plasticized with glycerine. And the "Elvanol" coatings can be made clear or pigmented with clay or titanium dioxide pigments.

"Elvanol" Offers Production Advantages, Too

"Elvanol" won't soften during the corrugating operation as many other coatings will. By eliminating sticking or blocking on the corrugator, you save paper, cut machine down-time and get a more efficient coating and corrugating operation.

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Alfred H. Nadelman, 2327 Tipperary Rd., Kalamazoo, Mich.
Orthmann Laboratories, Inc., 922 N. 4th St., Milwaukee, Wis.
Skinner & Sherman, Inc., 246 Stuart St., Boston, Mass.
John H. Sutliffe, Font Grove Rd., Slingerland, N. Y.
U. S. Testing Co., 1415 Park Ave., Hoboken, N. J.
E. F. Whittington, 530 W. Cedar St., Kalamazoo 45, Mich.
Wiley & Co., Inc., 904 N. Calvert St., Baltimore, Md.
Williams Apparatus Co., Herald Bldg., Watertown, N. Y.
D. L. Amos, MacMillan & Bloedel, Ltd., Port Alberni, B. C.
W. W. Brown, Howe Sound Pulp Co., Ltd., Port Millon, B. C.
D. F. Church, Crown Zellerbach Corp., Camas, Wash.
Clarence T. Clark, Restigouche Co., Ltd., Campbellton, N. B.
Clarence A. Enghouse, Crown Zellerbach Corp., West Linn, Ore.
B. Roy Gibson, St. Joe Paper Co., Port St. Joe, Fla.
A. B. Gorham, Ontario Paper Co., Ltd., Thorold, Ont.
Eric T. Guest, MacMillan & Bloedel, Ltd., Nanaimo, B. C.
Nelson Hartnagel, Fiberboard Products, Inc., Port Angeles, Wash.
C. D. Ingram, Hollingsworth & Whitney Co., Mobile, Ala.
N. S. Lea, Scott Paper Co., Everett, Wash.
Robert R. Marriott, Crown Zellerbach Corp., Port Townsend, Wash.
C. L. Smith, National Container Corp., Jacksonville, Fla.
G. R. Tennent, Continental Can Co., Hopewell, Va.
M. Wayman, Columbus Cellulose Co., Prince Rupert, B. C.
F. J. Weleber, Publishers Paper Co., Oregon City, Ore.

Industry Notes

Production

January production of paper and paperboard is estimated to have been 2,065,000 tons. This was about 140,000 tons, equal to 6% less than in January, 1953, when output for the month amounted to 2,205,000 tons. Nevertheless, for the month, paper and paperboard mills ran at 94 and 89%, respectively, and the industry merited the following comment from the February Bulletin of the National Association of Purchasing Agents: "This industry stands head and shoulders above all others in the nondurable field in hanging on to the boom. Even though there is a leveling off in both production and consumption, there is every assurance that 1954 will prove another banner year, although it is only natural that there will be an exceptionally careful watch over inventories."

Of the two major segments of the industry, paper and paperboard, the former evinced a greater stability during the month, as production at 1,048,000 tons approximated the volume of January, 1953.

The production of printing paper (book and ground wood), at 305,000 tons, exceeded the level achieved during November and December of 1953 and was within a thousand tons of the output recorded for January of last year. Further, the volume of orders received amounted to 300,000 tons, indicating that demand for those grades had continued at a satisfactory level. The backlog of unshipped orders, at the end of the month, although below the peak of last year, approximated that of a year ago.

Fine paper production, estimated to have been 100,000 tons, was 4% less than that of January, 1953, and well below the outputs of January, 1951, and 1952, respectively. Shipments at 102,000 tons were slightly in excess of production and, as a result, the backlog of orders on hand, despite an improvement in the volume of orders received, decreased to about 32,000 tons.

In the coarse paper segment, output for January is estimated to have been 286,000 tons, about 1% less than i uary of the preceding year. New orders, although at a level than in the last two months of 1953, were abou tons below the level for January of that year. Shipm 280,000 tons were less than production and, as a resu backlog of unshipped orders rose to 168,000 tons, ec about 14 days' production.

Tissue paper was one of two grades whose output month exceeded that of January, 1953, as proc amounted to 127,000 tons. With new orders for the amounting to 130,000 tons it appears this strength w tinue in the immediate future.

Newsprint output also exceeded that of a year ago as tons were produced approximating that of October, th month of last year.

The production of paperboard, including wet-m board, as previously indicated, accounted for the bulk total decrease for the industry as output of 925,000 to 106,000 tons, equal to 10%, less than the preceding Ja Considering only that tonnage reported to the N Paperboard Association a backlog of orders of 331,0 compared to 455,000 tons a year ago, a decrease of 27%

Pulpwood

Preliminary data for 1953 show that total receipts fo wood were 27,851,000 cords, an increase of 2% over Domestic receipts increased from 25,027,000 cords to 2 000 cords, while imports declined from 2,308,000 c 1,548,000 cords. Regionally, increases ranged from the Pacific Northwest to 20% in the Appalachian Decreases were registered in the Northeast and Lake Regions, 21 and 13%, respectively.

Consumption for last year amounted to 28,115,000 an increase of 6% cent over the previous year. In ranged from 4% in the Pacific Northwest to 11% in the Only the Northeast Region showed a decline—5%.

At year-end, inventories were 5,650,000 cords, a de 5% under stocks on hand at the end of 1952. Invent creases were reported in the Appalachian and S Regions, 15 and 27% respectively. The Pacific, Lak and Northeast Regions showed declines of 1, 16, and 1 that order.

Wood Pulp

Based on preliminary census data, wood pulp pro for 1953 totaled 17,525,000 tons, an increase of 1,052,0 over 1952. The principal increase in production was bleached sulphate, 542,000 tons. Minor declines w ported for dissolving and unbleached sulphite grades.

Consumption of wood pulp last year amounted to 1 000 tons, approximately 1,400,000 tons above consump 1952. Bleached and unbleached sulphate pulp consu increases totaled 1,076,000 tons.

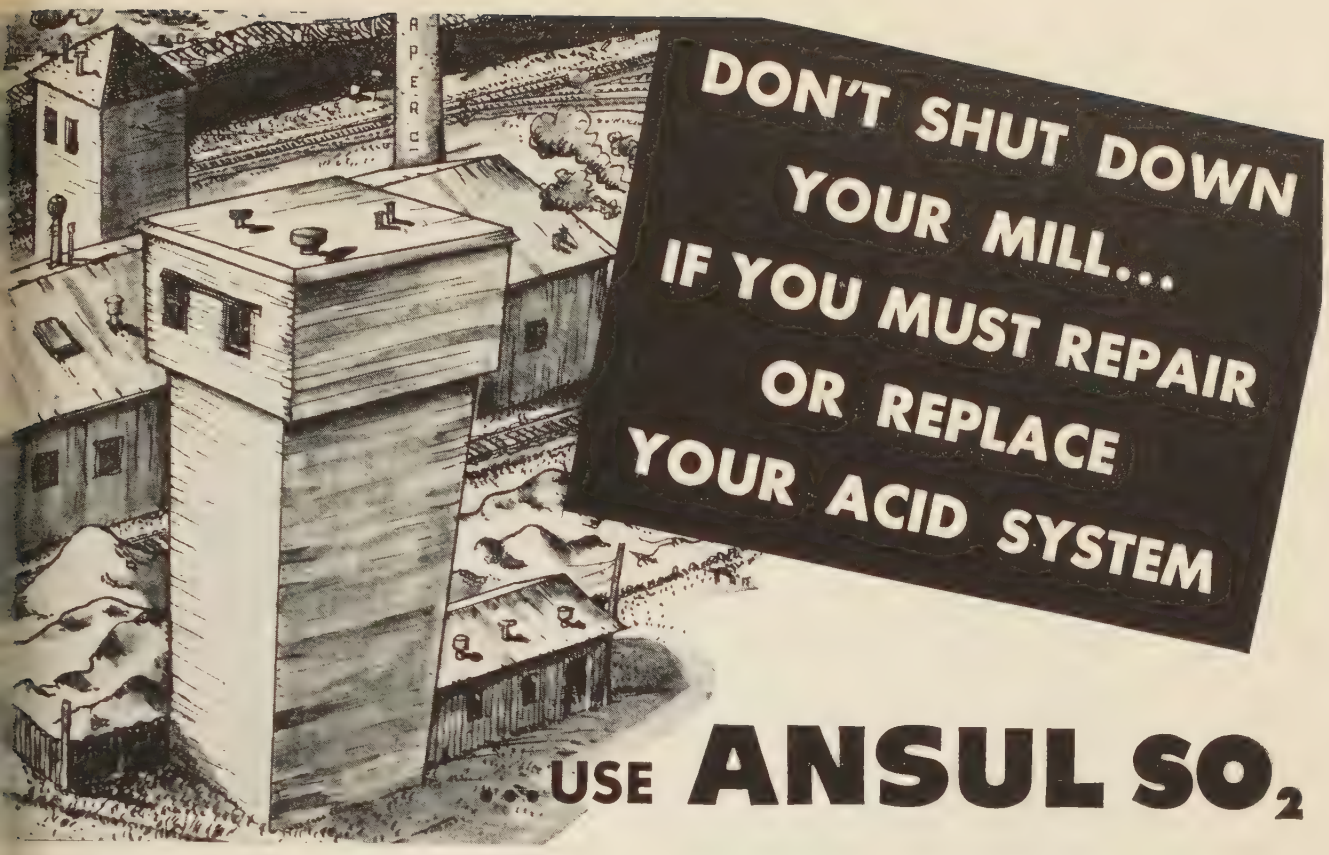
Wood pulp imports this past year increased 11% o ports for 1952—2,156,285 tons as against 1,941,35 Imports from Canada increased from 1,581,214 t 1,613,684 tons. Overseas imports increased from tons to 542,601 tons.

Exports for 1953 were 153,000 tons, 59,000 tons un

United States Imports of Wood Pulp (in Short Tons)

	Sweden	*Finland*	*Norway*	*Russia*	*Austria*	*Italy*	*Czechoslovakia*	*France*	*Germany*	*Switzerland*	*Denmark*	
1946	445,114	115,220	0	0	0	0	0	0	0	0	0	56
1947	555,215	223,973	9,577	4928	0	0	0	0	0	0	0	79
1948	384,576	175,900	13,218	0	1,696	0	0	0	0	0	0	57
1949	265,621	148,903	29,208	0	4,459	0	1027	0	0	0	0	4
1950	398,814	205,651	28,958	9773	21,005	167	2597	115	977	89	0	6
1951	258,461	182,616	36,365	0	3,225	0	512	106	2812	15	15	4
1952	190,364	145,886	21,168	0	2,430	0	0	124	169	0	0	3
1953	334,813	160,216	36,777	0	9,996	0	0	211	588	0	0	5

[a] Includes 4 tons from Australia.



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Sources of Newsprint Used in the United States 1913–53 (Short Tons in Round Numbers)

Year	U. S. production	U. S. exports	Imports into the United States: From Canada[a]	From Europe	Total	Available for consumption	Year
1913	1,305,000	50,000	147,000	...	147,000	1,402,000	191
1915	1,239,000	63,000	329,000	4,000	333,000	1,509,000	191
1920	1,512,000	46,000	680,000	51,000	731,000	2,197,000	192
1925	1,530,000	23,000	1,315,000	133,000	1,448,000	2,955,000	192
1930	1,282,000	10,000	2,145,000	134,000	2,279,000	3,551,000	193
1935	912,000	22,000	2,186,000	197,000	2,383,000	3,273,000	193
1940	1,013,000	44,000	2,749,000	34,000	2,783,000	3,752,000	194
1945	724,000	44,000	2,669,000	...	2,669,000	3,349,000	194
1950	1,015,000	44,000	4,693,000	171,000	4,864,000	5,835,000	195
1953	1,084,000	47,000	4,840,000	164,000	5,004,000	6,041,000	195

[a] Includes Newfoundland.
Sources: Production data compiled from Newsprint Service Bureau records. Import and export data based on U. S. Department of Commerce report

ports for 1952. During the last four months of 1953 exports of wood pulp were double those of the first eight months of the year.

Inventories at the end of the year were 658,000 tons—145,000 tons at wood pulp mills and 513,000 tons at paper and board mills. Inventories in December increased 10,000 tons over November but were 53,000 tons under inventories at the end of 1952.

Newsprint

Production and shipments of newsprint in North America during January, 1954, amounted to 572,435 tons—an all-time record for this month—and to 547,602 tons respectively, compared with corresponding totals of 567,429 and 561,535 tons in January, 1953. Output in the United States was 96,284 tons and shipments were 95,132 tons while Canadian (including Newfoundland) production amounted to the record January high of 476,151 tons and shipments to 452,470 tons.

United States mills turned out 2495 tons or 2.7% more newsprint than in January, 1953, while output in Canada also was 2511 tons or 0.5% greater than in the corresponding month of last year, thus the continental increase totaled 5006 tons or 0.9%.

Wastepaper

Each of the 159,696,000 inhabitants of the United States last year salvaged an average of 106.9 lb. of wastepaper. This was an increase of 4.7 lb. over the per capita average in 1952, but 15.6 lb. less than 1951.

Never before except in 1951 at the height of the Korean war was as great a tonnage of wastepaper purchased by the Eastern consumers during the months of January and February as during these two months in 1954.

New Wastepaper Grades

Circular WP-54, covering Waste Paper Standards and Practices as approved by the Waste Paper Institute of NAWMD, has been issued by that Association. With the exception of the addition of one paragraph to the Preamble, all of the changes occur in Section VI—Grade Definitions. Section I (The Purchase Agreement), Section II (Fulfillment by the Seller), Section III (Fulfillment By the B Section IV (Miscellaneous Practices), and Section V tration) remain unchanged from WP-49. Four new definitions have been added to Section VI. They are:

New 100% Brown Kraft Corrugated Cuttings—Consis baled corrugated cuttings having all liners and corruga dium of 100% brown kraft fiber, free from solid color p Butt rolls are not acceptable in this grade. Outthrows n exceed 1%. No prohibitive materials are permitted.

Used Brown Kraft Sugar and Flour Bags—Consis baled, untreated brown kraft sugar and flour bags. Ou may not exceed 1/2%. No prohibitive materials are per

New Brown Kraft Bag Waste—Consisting of new brow cuttings and sheets, including misprint bags. Stitc sewed papers are not acceptable in this grade. Outthro not exceed 1%. No prohibitive materials are permitted.

Publication Blanks—Consisting of baled, unprinted c or sheets of white coated or filled white groundwood paper. Outthrows may not exceed 1%. No prohibitiv rials are permitted.

Two grades, colored kraft and blueprint, have been and Manila Tabulating Cards and Super Manila Tab Cards have been combined under the heading, Tabulating Cards. This results in 43 wastepaper gra nitions as compared with 42 in WP-49.

Value of Imports

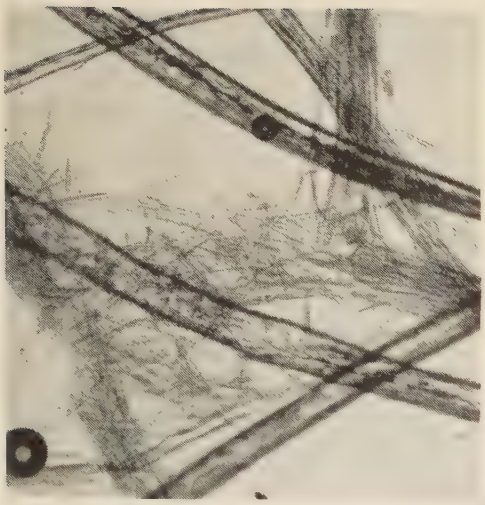
The value of imports of papermaking raw materials paperboard, and paper products for 1953 and 1952, as r in the monthly reports of the Bureau of the Census f and 1952 is as follows:

	1953 (P)	1952
Total	$933,331,093	$925,801,344
Pulpwood	33,708,818	47,016,543
Wood pulp	263,190,152	271,764,738
Rags, bags, grasses, etc.	4,300,317	7,034,036
Paper	609,276,824[a]	581,807,380[b]
Paperboard	14,360,935	10,663,336
Paper products	8,494,047	7,515,311

(P) Preliminary.
[a] Includes newsprint at $594,801,697.
[b] Includes newsprint at $571,790,615.

Wastepaper Recovery

	1951	1952	1953
Population of U. S.	154,353,000	155,767,000	159,696,0
Total U. S. production of paper and paperboard, t.	26,048,000	24,413,000	26,566,0
Total imports to U. S. of paper and paperboard, t.	5,139,254	5,173,352	5,212,8
Total production and imports of paper and paperboard, t.	31,187,254	29,586,352	31,778,8
Total exports, paper and paperboard, t.	527,895	498,111	475,9
Total U. S. consumption of paper and paperboard, t.	30,659,357	29,088,241	31,302,8
Average per capita consumption, paper and paperboard, lb.	397.2	373.5	3
Wastepaper, purchased by consumers, t.	9,252,000	7,813,000	8,426,0
Wastepaper, exported, t.	206,438	144,815	113,7
Wastepaper, total salvaged, t.	9,458,438	7,957,815	8,539,7
Wastepaper, salvaged per capita, lb.	122.5	102.2	1
Ratio of recovery of wastepaper to consumption of paper and paperboard, %	30.8	27.3	



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ECUADOR

The Department of Commerce reports that the mai kraft paper in Ecuador has been expanding so much re that construction of a modern paper bag factory has in Quito. The new plant will have a daily capa 50,000 bags.

FINLAND

The final economic results of 1953 were much more able than could have been predicted earlier in the yea the Finnish economy was laboring under severe diffi caused by the high level of domestic costs in relation t prices for forest products. In the first months of the y prices of Finland's principal exports had declined to that were somewhat less than half of those prevailing height of the Korean boom; at these prices exports o products, particularly cellulose, were unprofitable, wh industry to curtail production so as to avoid excessive The decline in the value of foreign trade had a cont effect on the whole economy. A reduction in timber contributed to the growth of unemployment, which rea postwar peak in March; imports were drastically curt keep them within the limits imposed by reduced earnings; and supply shortages developed in home industries which were, however, able to produce at a rel high level since import licensing restrictions greatly r foreign competition.

As a result of the strong demand for all major expor and the appreciable price increases in the final q coupled with the decline in import prices occurring in Finland's terms of trade have improved by about 10% pared with the 1953 average of 124 (1935 equals 10 present prices prevail through 1954 the Ministry of F estimates that exports this year will exceed 140 billion (\$600,000,000). The favorable future development land's trade is also indicated by the agreements con with the USSR and UK to govern 1954 exchanges; should result in a more advantageous trading relat with both countries, and Finland's economic depende the USSR is expected to decline as a result of the ant growth in its exchanges with the UK, which should ag come its leading trading partner.

The improvement in Finland's terms of trade has m possible to postpone for the time being a solution of th lem of high production costs. This improvement pl effect of tax alleviations and the refund to industry of tion of the special taxes levied on export earnings dur 1951–52 boom has served to restore the profitability ports; cellulose is still in the least advantageous positi the proceeds of export sales now permit this branch to even whereas substantial losses were formerly the ru would be a mistake, however, to conclude that this pro now a thing of the past. It is actually one of first mag in the metal industry and in home market industries eral, as well as in agriculture. Measures for its solutio eventually be taken if Finland is ever to achieve a economy with a price and cost structure in balance wit of the outside world. Should the present favorable te trade turn adverse, the solution of the problem co longer be indefinitely postponed. Unless Finnish co brought into line with world prices it will be impossi proceed further on the path of lifting economic control the liberalization of foreign trade and the exposure of market industry to competition from abroad would serious economic difficulties.

The growth of output in the export industry occurr the Fall was stimulated by the firm demand for cel lumber, and paper prevailing in the second half of th accompanied by moderate price increases in some inst The need to replenish stocks which had been reduced t

w levels in the cellulose industry because of previous below pacity operations was another factor in the growth of pro- ction in that branch. It was, however, remarkable that e output of the paper and cellulose industries, as measured the official index, reached a level in October-November at was higher than any previous month in the postwar in- ding even the boom year 1951. Spokesmen for the export dustry continued to maintain that the problem of restoring e competitive ability of Finnish exports on world markets d still to be solved but it was obvious that the production st problem had been considerably alleviated during the sing months of the year when foreign demand strengthened tably, and appreciable increases occurred in the prices of lulose, paper, and other forest products. The position of export industry was further eased by the government's de- on to refund to it 4.2 billion Fmks. ($15,600,000) de- ted from export earnings in 1951–52 and to remove the nover tax on raw materials and supplies used by the in- try. In the case of cellulose, these alleviations and the rease in the export price of approximately 5 pounds sterling ton to the UK and continental markets removed practi- y all of the previous loss on sales, calculated officially at 0–9000 Fmks. ($25–$38) per ton. Practically all other jor exports are being sold at a profit although the margin ain is small in most cases.

An outstanding feature of the capital improvement program ler way in the woodworking industry is the projected ex- sion in Finland's newsprint capacity which will rise by at 45% during the next three years as a result of the entry operation of two large mills now under construction and planned extension of two existing plants. The actual in- ase in capacity will be from 496,000 metric tons in 1953 to ,000 metric tons in 1956–57, according to estimates of the nish Paper Mills' Association. Most of this increase will accounted for by the Kaipola mill of the United Paper lls' Co., which will have two newsprint machines with a al capacity of 120,000 metric tons annually and by the of Enso Gutzeit Oy., at Summa with a capacity of 80,000 tric tons. Both of these projects will be equipped with erican newsprint machines, the cost of which is being nced from the $20 million IBRD loan granted to Finland 1952. In view of the constantly rising curve of world news- nt consumption the Finnish Paper Mills' Association an- pates no difficulties in placing the approximately 200,000 tric tons additional newsprint tonnage on foreign markets. e Association hopes that sales to the United States can be reased by 20–50,000 tons annually from their present ex- production. The projected additions to Finland's news- nt capacity will bring a notable rise in industrial output and eign exchange earnings with beneficial effects for the econ- y.

EDEN

Sweden's lumber, pulp, and paper industries ended the st calendar year on a very strong note with every indication t the current "bullish" optimism and success will continue l into 1954 at approximately the present level.

Official preliminary reports estimate that the chemical lp produced in 1953 was 2,439,900 metric tons, a 7% in- ase over 1952 while the output of paper and board rose in e corresponding period to 1,226,057 metric tons, a new ord *21%* above 1952 production. Pulp exports (combined echanical and chemical grades) soared in volume, from 30,099 metric tons in 1952 to 2,163,416 last year but de- ned in value from 1,539,340,000 to 1,296,713,000 Swedish owns in the last two consecutive years. Special importance, m a trade and balance of payments standpoint, is attached chemical pulp shipments to the United States, which in- ased from 187,358 metric tons in 1952 to an estimated 3,750 tons in 1953. Likewise exports of paper rose tonnage- se, from 535,948 to 677,224 metric tons but declined in

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value from 649,930,000 to 583,619,000 Swedish crowns in the past two calendar years.

While pulp prices continued to edge upwards and stocks dropped to about 160,000 tons for the first time since February, 1952, Swedish trade circles continued to complain prices were still below "normal" levels and the fear of an American pulp surplus dampened the hopes of retaining the present strength in that market after the middle of 1954.

The Forest Owners Association of Skane decided on Dec. 7, 1953, to raise 6,000,000 crowns ($1,200,000) and form a joint-stock company to build—presumably in 1955—a 17,000-metric ton mill at Broby, north of Kristianstad, to produce semichemical pulp from the second-grade timber along the Helge River no longer merchantable as firewood. A smaller cooperative of farmers in Adalan (Smaland) are talking about building a sulphate mill in that vicinity. The two-year-old scheme of the Southeast Swedish Forest Owners Federation to build a 60,000-ton sulphate mill at Monterås, near Karlshamn, appears to be further from actual fruition with the announcement that some of the 80,000,000 crowns ($16,000,000) they raised was spent to buy the small 60-year-old Fridafors wallboard and groundwood mill north of Karlshamn. Serious competition to the established large mills in northern Sweden is never expected to materialize.

Panama

A company to process and package paper products, principally toilet paper, was organized in Panama on Sept. 28, 1953, under the name of Industria Papelera Nacional, S. A., with a capital of $50,000.

Industria Papelera Nacional, S. A., is presently importing from the United States all material needed in its processing operations. An official of the company reported its monthly output at 1600 cases of 100 rolls each (rolls of 650 and 1000 sheets each) of toilet paper, all processed from an approximate monthly import of 30 short tons of toilet paper.

Mexico

Within a period of three years Mexico will be able t
duce sufficient newsprint to take care of all its internal
according to Secretary Gilberto Loyo, of the Departm
National Economy. Three major newsprint plants are
constructed in Mexico, reported *The World's Paper
Review*, Feb. 4, 1954.

According to studies recently undertaken by a comm
of German experts sent to Mexico by the United Na
their report stated that despite the "criminal" destruct
trees, the forest riches of the Republic are the highest in
America.

With the creation of a newsprint industry, Mexico
freed of imports from Canada and Europe, thus saving m
of pesos. And, at last, an orderly exploitation of the na
forests appears to be on the horizon.

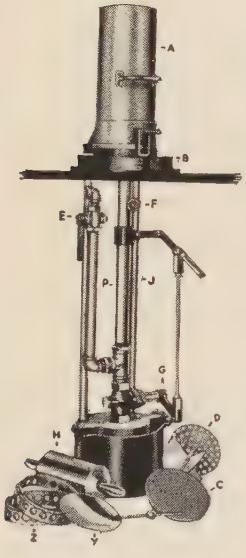
It was stated that forest lands of Durango or Michi
alone could permit the production of wood pulp for new
on such a high scale that consumption three times greate
present demands could easily be satisfied.

It is understood that United States interests are lo
into the construction of a wood pulp mill in either Dura
Michoacan. However, amount of investment and oth
tails are lacking pending the selection of the site for th
jected paper mill.

There is considerable interest in Mexico in the esta
ment of paper mills utilizing cane waste. Bagasse mi
to be set up in Zacatepec, Morelos, and Veracruz,
Mexico's largest sugar mills are located.

The current government policy is to lend every possib
toward the establishment of wood pulp or bagasse mill
there will be no official hindrance or red tape. Foreign
tal, in collaboration with Mexico, is welcomed in the de
ment of the national paper industry.

This swing toward self-sufficiency in newsprint is in kc



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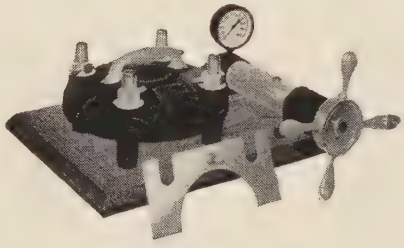

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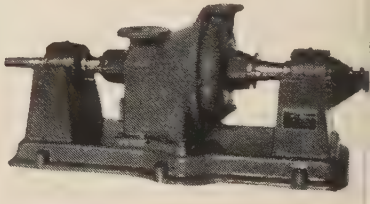

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ith the current administration's policy to cut down imports herever possible, and especially in fields where Mexico's vn national resources (such as timber) are very rich.

ELAND

It is reported that Irish-American interests intend to es- blish in Kenmare, County Kerry, a plant producing up to 200 ns of newsprint daily.

In addition to newsprint, kraft and tissue will also be made Kenmare, and the plant's construction—taking about 18 nths—will cost upwards of £70,000, employing local labor d Irish materials when available. Planning also includes ure construction of a pulp mill providing a completely inte- ted operation.

Until such time as pulp is available locally at Kenmare m the surrounding plantations it will be imported. It is imated that, due to the favorable local conditions, mild ather, rainfall and terrain, native grown pulpwood will be dy in from 10 to 15 years in sufficient quantity to supply mill's raw material. It is estimated that when the ject is in full operation 1000 workers will be employed.

IO

A few crumbled piles of brick, an old well, and a vacant ce of land, thickly overgrown with weeds and brush, are that remain of what was once a paper mill in the village of odsdale, Ohio. Driving down a winding road bordering former mill site, the traveler can still see an incredibly old rundown building said to have been constructed from the cks of this mill.

ocated in the center of Ohio's paper industry, the Miami ley, Woodsdale lies 3 miles south of Trenton and 8 miles th of Hamilton. A French family, the Augspurgers, tled here in the early nineteenth century. They were mers, distillers, operators of a saw and grist mill; the almost traditional story of the prosperous pioneer in this area. As a settlement grew around their enterprise they built a dam to develop the river's power. Then they set their sights higher and looked toward industry. It was the last year of the Civil War and paper brought 25 cents per pound. William Beckett and Adam Laurie of Hamilton's mill became interested. William Woods and William Chatfield of Cincinnati joined. Together with Samuel and Frederick Augspurger these men became the original incorporators of the new mill. The firm was first known as the Beckett Paper Co., 27 years before today's company of the same name assumed that calling. Shortly after the new mill began operations, its name was changed to The Woodsdale Paper Co. The village assumed its name to honor the firm's president William Woods. Chatfield and Woods, Cincinnati jobbers, subsequently became quite influential, handling papermaking raw materials and wholesaling almost exclusively the products of the two mills with which Beckett was connected.

The new mill was equipped with one fourdrinier machine of 76-in. width. Its main building was 40 by 100 ft. with three stories. Book was the principal grade. Although soundly constructed, there was something preposterous in this mill's design by today's standards. The machine ran toward, instead of away from the beater room, so that the stock had to be pumped for the entire length of the machine. "The broke was made where it was handy to furnish directly back into the beater." One can only add, that the designers did not show too much confidence in the operators.

The smoothly functioning mill was preceded by a time of troubles. Superintendent Doblinski was the first trouble. Young, just out of school, not too serious in outlook on life, he was a great lover of baseball. He and the help would hitch the mill horses to the mill wagon, shut the mill down, and (singing merrily) would take off for Hamilton whenever a baseball game was to be seen. Doblinski did not last long.

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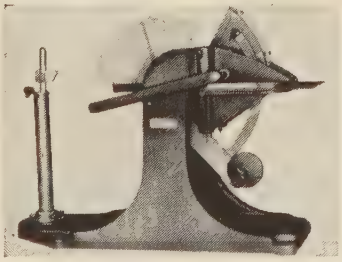

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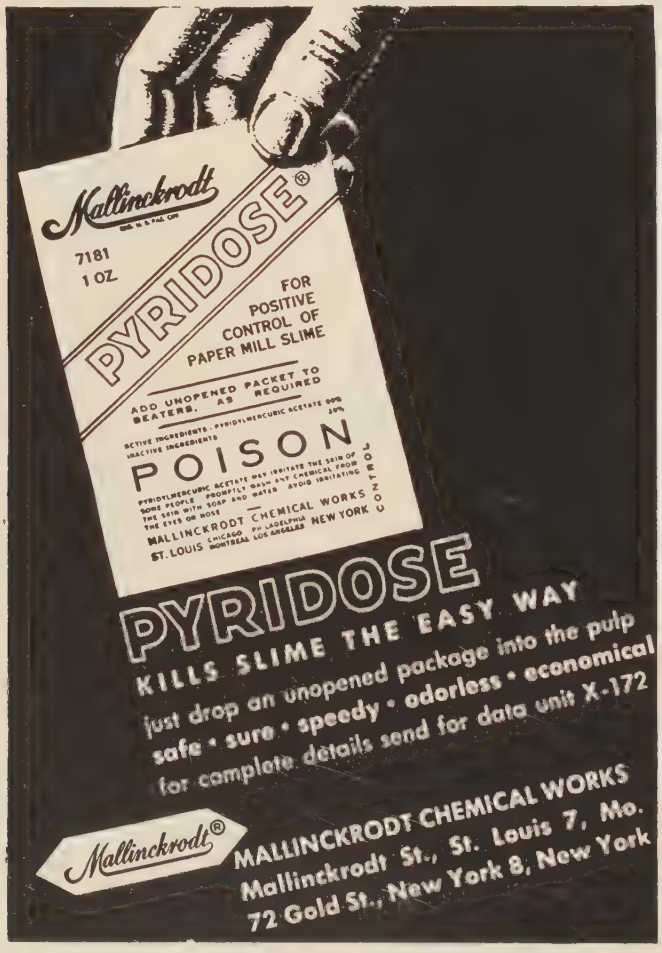
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Another source of trouble was the Downey Brothers "Sandy" and Bill ran the machine, brothers and John fed the beaters. Sons, sons-in-law, and oth ends of the family ran the supercalenders and most of of the equipment, according to their own ideas and boss who differed. Superintendents came and went, s ing each other with disgusting frequency and alarmingl tenure until George Bryant appeared. He arrived w express understanding that he would have a free hand first action was one of wholesale firing. After the "f was out he brought in new help, quieted things, and down to the serious business of making paper, and incid made a success of the mill.

Solomon Wagg was a later superintendent, comin another forgotten Ohio mill: the mill in Delaware, here previously. Wagg must have been a man with over his head, because he left one doomed mill only another, one destined even earlier for extinction. The dale mill, after finally having become a going concern, suddenly under shocking conditions. Men had ju work on June 24, 1880, when smoke was noticed, comi the rag room. Hurrying up the stairs leading to the story of one wing, workers found that section in flam Holley pump, which according to a contemporary issu *Paper Trade Journal*, "was sufficient for all purpose turned on. But the wheel slipped from its gearing. A fire hose was burned.

The mill employed 60 people, mostly Scottish and fold. Woodsdale then consisted of many well-kept c on the west bank of the river and was described as on prettiest spots in southern Ohio. The last mill mana D. W. McClung, who married one of General Benjam rison's nieces. When Harrison became President United States, McClung became postmaster of Cincin papermaking "politician!"

Little else remains to be told. After the fire, pla made to rebuild the mill. Among the many improv proposed, was a railroad bridge for service by the Cir and Western R.R. The county was to contribute fina to this project. However, the county commissione insufficiently cooperative and there the plans "fa Plans for rebuilding were abandoned, leaving the shouldered with a huge obligation for maintenance dam; an obligation which lasted for many additiona And so ends another chapter in the history of paperma Ohio.

—by Ernest F. Barker, in *Ohio TAPPI*, March 9, 1954.

Wisconsin Stream Pollution

A major shift in spent sulphite liquor research was in the 1953 annual report of Averill J. Wiley, technica tor, the Sulphite Pulp Manufacturers' Research Leagu

Industry scientists for the past 80 years have believ could divert the greatest tonnages of spent sulphite from the streams by seeking uses for the whole liquor. have preferred this to hunting processes that would certain individual fractions while leaving the rest of th to be otherwise disposed of.

League researchers have perfected three big-tonnage liquor techniques: evaporation-burning, roadbinde torula yeast. Several other whole liquor researches process, and these may find some substantial uses. whole-liquor field appears to have been rather tho worked over, and the future seems likely to see more nage uses uncovered from the relatively unexplored fractions.

The League's research in recent months has shifted liquor fractions and away from whole liquor. This ch scientific direction should lead more surely and more p to the big-tonnage uses which alone can solve the pollution problem for all time to come.

Wisconsin sulphite pulp mills have paid out more than 0,000,000 on research and other work to abate sulphite pol-tion and eventually will have to spend at least $15,000,000 ore. In the League's 1953 annual report, J. M. Conway, esident of the League and also of Charmin Paper Mills, reen Bay, forecast that to clear Wisconsin streams of sul-ite pollution will require the industry to make an invest-ent totaling at least $25,000,000 when science learns how to mplete the job.

LLUTION LEGISLATION

Representative Kersten (R., Wis.) has introduced H.R. 51. This bill would add a new section, 124C, to the Rev-ue Code to provide that any person who constructs, erects, ., a pollution-control facility may elect to take a deduction h respect to the amortization of the adjusted basis—for ermining gain—of such a facility based on a period of 60 nths.

E SULPHITE

Technicians of Stora Kopparbergs Bergslag have developed ew sulphite cooking method for making paper cellulose m pine wood instead of the usual spruce wood. The tskar sulphite mill, which is working on the basis of sodium lphite, will be changed over to the new method, and the ce quantities hitherto used there will instead be turned r to the company's newsprint mill at Kvarnsveden, the acity of which will be increased by 40,000 to 45,000 tons ually by the adding of a new paper machine.

Earlier, it has not been feasible to use pine wood in the sul-te process because of the difficulties in dissolving the pitches the heartwood. This problem has now been solved by g a two-stage cooking method on the basis of sodium bi-phite. The pulp obtained is light in color and strong in r and has proved to have very good properties for manu-uring printing papers, etc.

BLE PAPER

A new Bible paper, representing the first major advance in manufacture of Bibles in thirty years, is announced by e World Publishing Co. with the publication in March of a w series of Bibles printed on "World Indo-Text," a thin, tweight paper, exceptionally white, very opaque, and h high tensile strength.

Now for the first time anywhere, Bibles will be available at ular prices printed on this unusual new India paper that ompasses, and in many respects surpasses, the virtues of traditional and far more costly India paper.

The term "India" has long been used to describe the in-dibly thin, tough, opaque papers made originally by hand the ancient Chinese from bamboo fiber. The art spread tward during the centuries—by caravan routes to Samar-d, gradually to Egypt, North Africa, Spain, and Italy. ewhere along the line it became known as "India" paper, name still used to designate certain fine papers used in ensive Bibles.

The Problem: India Paper at a Popular Price. For years World Publishing Co. has been seeking a way to secure a r of the toughness, thinness, and opacity of India paper, ch could be used in the millions of popular-priced Bibles firm publishes each year. Despite the fact that paper rts considered it impossible, The World Publishing Co. sed to give up the idea. Five years ago World succeeded rsuading a leading paper maker to work with them on this ect. Inspired by the challenge and the opportunity, chemists and engineers began experiments. Emergen- and paper shortages interfered, but the patient testing on. Many vats of paper pulp were made—tested—and wn back. Dozens of different sheets were tried and put ery test, both in the laboratory and on the presses at the ld plant. Finally, after five years of research, resource-

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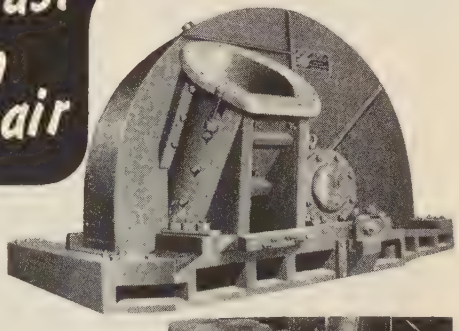

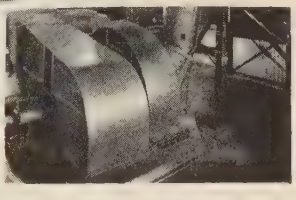

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fulness, persistence, and faith, Indo-Text was develop India paper far superior to the most optimistic hopes one concerned.

Why Indo-Text Is Important in Bibles. The new s World Bibles printed on Indo-Text are complete r editions, which means they include a Concordance column references, a geographical index, a self-pronu plan, eight pages of maps, four pages of full color illust and a six-page family register containing a famil All this takes 1360 pages. An average book which fortable to hold and easy to read contains about 30 and no one would want his Bible to be more than fou as thick and heavy as the average novel. The new Indo-Text Bible, with its 1360 pages, is only one an sixteenths of an inch thick and weighs only a little mor pound.

But this brings up another problem. Most paper thin and light is also so transparent that the type through from the opposite side of the page and m difficult to read. One of the greatest problems in c ing Indo-Text was to make it not only thin and light the same time opaque.

Particularly important in Bibles, where reference m is often printed in smaller type than the text itself whiteness of the paper—or "brightness" as it is know paper and printing fields. This whiteness determi degree of contrast between the paper and the type its has a great deal to do with the ease of reading. In obtain the highest degree of whiteness for Indo-Text, t it is made from is bleached and treated until it is whi milk.

In addition to all of the above qualities importa paper destined for the printing of Bibles, it is easy to stand that this paper must also be strong. It mu without wearing or tearing, through frequent reading a years of use.

It is these five qualities which traditional India pap have—the thinness, light weight, opacity, whitene strength—which have made it preferred for the fines throughout the ages. It has been confirmed by all t comparisons that Indo-Text is at least equal to regul paper in thinness, weight, and strength, surpasses India paper in whiteness and opacity, and adds a new in its soft silken texture that is particularly pleasing the eye and the touch.

All of this takes on new meaning as an important bution of American technology when it is realized t new Indo-Text is available in Bibles at almost one-t cost of the fine India paper editions. The new Wor Text Bibles are available for as little as $3.50.

UNESCO Paper Report

In 1935, Singapore possessed only one importa newspaper with a circulation of 5000. Today the sam sells 53,000 copies each day and there are 15 other d five languages of which one, in English, has a circul 30,000 and another, in Chinese, a circulation of 50,000

These statistics on readership in Singapore give an of the need for newsprint which is likely to repe throughout the underdeveloped countries of the world

What can be done to meet this need?

Some possible answers and suggestions are giv publication released under the title "Paper for E Today and Tomorrow" written by the Intelligence the London Economist and presented jointly by the Nations Educational, Scientific and Cultural Orga and the Food and Agriculture Organization.

World demand has far outstripped world supply print, and the situation is bound to become wors efforts on a heroic scale are taken, the authors Because of the shortage many newspapers have been

op publication. In India alone, it is estimated that 1000 nall newspapers and periodicals were forced to close down ring 1951. Papers in many countries have had to reduce eir size and frequency of publication. Specialized and edutional publications have been especially hard hit. Hundreds millions of people now illiterate are determined to gain the od things of life which are available only to those who can ad; yet textbooks remain unpublished.

Moreover, scarce newsprint means poor newspapers, the thors contend, for they consider that the greater the supply newsprint the greater the opportunity for making newspers informative, intelligent, and universal in appeal. The inkage of newsprint, they indicate, is usually associated th insufficient coverage and a decline in quality because "the desirable news items, for which the demand is greatest," nost invariably encroach upon space formerly taken up foreign affairs, culture and science.

Many obstacles stand in the way of increasing the supply, report states. They include the need for capital investnt, marketing systems, high prices, lack of foreign curcies, and the limited availability of coniferous wood pulp—basic raw material for newsprint.

Further, the source of supply is limited, in the main, to rth America and Europe—two areas which at present sume nearly the total production. (For example, with % of the world's population, these two areas consumed % of newsprint production in 1950; the continents of Latin erica, Africa, and Asia, with 61% of the world's population, counted for only 10% of consumption.)

The prodigality with which Europe and North America our wood pulp should not, however, be ascribed to greed, authors declare. Experience shows that consumption paper products go hand in hand with industrial activity. e greater the volume of industrial production, the greater amount required not only for educational purposes and dy papers, but for advertising, packaging and wrapping, e manufacture of rayon and plastics, and other industrial es.

The new requirements created by the emerging educational, litical and economic advances in Asia, Latin America, and ica are therefore likely to be immense in the long run, e report indicates. It is conservatively estimated that rld demand for wood pulp in 1960 will reach the figure of million tons as against the 32 million tons used in 1950.

Besides examining the question of newsprint, the study ves information on the whole range of industrial materials ived from wood pulp, in order to give the picture of total ds in this field. Statistics show that of the 32 million ns of wood pulp produced in 1950 (excluding the USSR), but 4% actually came from Europe and North America—d all of it was consumed there, except for about 400,000 ns which became available for the rest of the world. Of this tal amount, the United States produced 42% and consumed %, showing a marked increase in production since 1937 25%) largely because of the development of the sulphate ocess which has made it possible to open up the pine regions the southern states, the report states.

The hard fact is that prospective world demand for all pes of papermaking materials is not likely to be met by tablished industries using the traditional raw materials, e report indicates. Nor is the idea of voluntary or governntal allocations to the hardest-hit countries desirable cept as an emergency measure, in the opinion of the authors, "the object should be to ensure that there is enough newsint to go around for everybody for who wants it," they y.

The only hopeful long-term solution, they contend, lies in establishment of new industries in underdeveloped untries which possess the requisite natural resources for permaking—not necessarily from the usual raw material, t from locally available fibrous material such as bagasse

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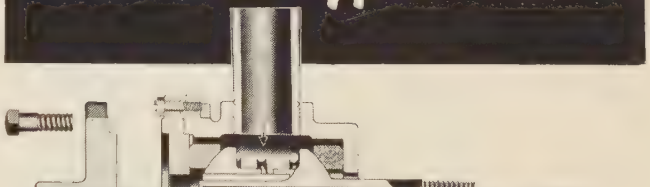
NEW Type JP Johnson Joint with Syphon Elbow



In the picture above you see a combination of welcome new ideas for the paper industry. It is built around the new Johnson Joint, which has been redesigned for lighter weight, lower cost, longer operating life. There's a special assembly plate to hold internal parts in position when the head is removed to get at the syphon pipe. And the syphon elbow is new altogether. It permits the use of straight pipe for the syphon connections, forms a tight seal when in position, and can be inserted or withdrawn right through the joint body, in many cases while the machine is operating.

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Pulp Classifier - - 4, 2 & 1 screen
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(sugar cane waste), bamboo, straw, and pulp wood from tropical forests.

Opening up new industries should not be conceived as a purely national effort, they believe. Emphasis should be put on increased regional production for several reasons, foremost being the heavy investment required. The cost of setting up a modern mill with a capacity of 50,000 tons a year, for instance, costs at least ten million dollars, and twenty million if it produces paper as well as pulp. Moreover, it takes up to five years before a mill can go into full production.

Considerable thought should also be given, the report states, to ways of increasing the supply of pulpwood available to existing mills through better utilization of wood, the improvement of machine performance and new pulping methods. To show the possibilities in this respect, they point out that "in the United States less than 50% of the total forest crop reaches the final consumer, the remainder being wasted or wastefully burned." In Northern Europe, "productive utilization of the crop amounts to only 75%."

New schemes are afoot in several countries, the report shows. Australia is processing hardwood for papermaking from a home-grown species of eucalyptus. In New Zealand, current plans provide for an annual production of 60,000 tons of newsprint, the raw material coming from the largest man-made forest in the world—200,000 acres of afforestation. Argentina is developing a newsprint industry to produce 75,000 tons a year, entirely from local materials. In Chile, a pulp and paper plant is being set up with the aid of a 16 million dollar loan from the International Bank for Reconstruction and Development; in 1952, the Chilean government announced the approval of a second project for a 10 million dollar newsprint mill to be financed by private United States investors.

FAO, which is directly concerned with forest problems, offers assistance to governments concerned with this problem, through expert missions sent to make on-the-spot st local potentialities of paper and pulp production help with planning the establishment of these new in in local areas. Technical assistance agreements sort of assistance had been concluded, when the rep prepared, with the following countries: Turkey, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Pe zuela, the Philippines, Thailand, Yugoslavia, and Gre

—from a press release of the United Nations Dept. of Public Info

Vacuum Pickup

The following Canadian newsprint mills are i vacuum couch transfers this year: Quebec North Sho Co., Baie Comeau, Que.; Powell River Co., Powell R C.; Canadian International Paper Co., Three River Consolidated Paper Corp., Three Rivers, Que.; Elk F Duncan Bay, B. C.

Sulfox Process

A new process is being introduced into the United St the efficient reuse of pulping chemicals in sulphite pu The Sulfox process is a practical and economical met recovering the chemicals of all soda base sulphite pr This system can be used for acid sulphite pulping verting from ordinary lime base to soda-base sulph will also work on neutral sulphite liquor recovery—b chemical or semichemical. Any of these liquors, in f be burned together with sulphate black liquor and the chemicals for each process separated later on.

In brief, in the Sulfox process the waste liquor is co evaporated, burned, and smelted, very much as is no ticed in the sulphate pulp industry. The resulting mainly sodium sulphide and sodium carbonate, is t solved and subjected to controlled air oxidation. Thi a mixture of sodium sulphite and sodium carbonate for re-use in making up sulphite cooking liquors.

Under present conditions, a typical sulphite mill u lb. of sulphur and 300 lb. of limestone (or 170 lb. of l every ton of pulp. With the Sulfox process, a mill w quire only 70 lb. of sulphur and 40 lb. of soda ash Other advantages of the Sulfox process are that most pulp mills using a lime base need little, if any, modifi order to change to the soda base. The use of soda, in lime, tends to improve the quality of the pulp. At the time, a number of mills are already cooking with t base. With the soda base, no scale formation and pr tion occurs, permitting the increased use of indirect methods, thus decreasing dilution in the process. steam is also provided. One ultimate benefit of the process is the obvious large-scale reduction in strea lution.

News Ink

The average ton of newsprint uses from 32 to 36 lb (28.2 to 32.4 lb. mineral oil, 3.2 to 4.3 lb. of carbon American newspapers have accounted for a 1 milli increase in mineral oil sales since 1950, over a 405,000 crease in carbon black sales.

Chestnut Hybrid

The American chestnut tree, which disappeared fr 000,000 acres of forest land since it was hit by an Asiati in 1904, may return to the American scene as a hybrid.

Department of Agriculture experts have developed nese-American cross-breed which appears resistant disease.

Test trees in the experiment are now 18 years widely planted, they may become an important so hardwood, according to the department.

PULATION

The nation's population has jumped to 161,100,000, an in-ase of 9,968,000 since the 1950 census, the Census Bureau orted recently.

ERLINGUA

Scientistas e technologistas es dar le mundo un nove median de munication—un lingua appellate "Interlingua." Chances you read this sentence without difficulty; to check rself, here is the English equivalent: Scientists and ineers are giving the world a new medium of communica-—a language called "Interlingua." New language was eloped by international group of technical men anxious implify exchange of ideas in science. Latest publication ting to it is "Interlingua a Prime Vista" (Interlingua at t Glance). Witty and interesting, book uses simple rings to teach vocabulary and grammar. Available Storm Publishers, New York 3; price $2.00.

nterlingua is described by its proponents as a union of European tongues (English, French, Italian, Spanish, uguese) with peculiarities of each omitted. Primarily nguage to be read, it can also be spoken. Purpose is to supplant other languages but to give scientists a means nowing results of work in other countries without having earn several languages. Publications in Interlingua are *troscopia Molecular*, a monthly bulletin on molecular troscopy published by Forrest F. Cleveland, professor hysics at Illinois Institute of Technology, Chicago 16; Interlingua grammar and an Interlingua-English dic-ary published by Storm Publishers; and *Scientia Inter-nal*, a monthly edition of *Science News Letter* published nterlingua division of Science Service, New York 3.

re is John Steinbeck in Interlingua, as translated from *of Eden* by Dr. Cleveland: "E isto io crede: que le te libere e explorante del individuo es le cosa le plus pre-in le mundo. E pro isto io combatterea: le libertate mente a prender qualcunque direction que illo desira, esser dirigite. E contra isto io aebe combatter: qual-eque idea, religion, o governamento le qual limita o destrue dividuo."

CUTIVE TRAINING

Most executives fail because they are not active, creative, ginative individuals, Morris I. Pickus, president of The sonnel Institute, Inc., declared recently at a luncheon ting of the Synthetic Organic Manufacturers Association he Hotel Commodore.

The difference between a $10,000 a year man and a $40,000 ar man, said Mr. Pickus, one of the pioneers in the field uman engineering, is that the $40,000 man has the ability ccept heavy responsibility without undue anxiety, the acity to make sound judgments under pressure with no ic or aggression, and the ability to get things done with help of others.

e proposed this realistic, four-step approach to manage-t development:

Start at the top level. Figure out a plan that will te in an "entrenched" $50,000 a year vice-president a desire to improve his job performance and eliminate e of his bad habits.

Approach the executive as an individual. A good utive development program must write a specific pre-tion pointing out the executive's areas of strength and they can be further developed, as well as his areas of ness and how he can minimize them.

Develop a follow-through program that will see to it the executive takes the prescribed "improvement icine" regularly and continuously.

Set up a specific improvement program for each vidual's job performance. Each year, review the pro-n with the individual and determine in dollars and cents value of the project that the executive has completed.

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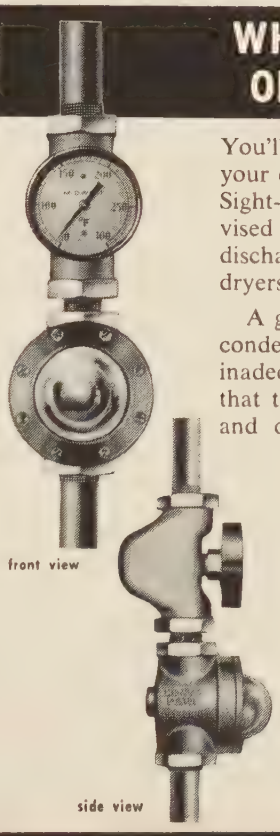

You'll know the score if you keep your eye on the ball—on The Ball Sight-Flow Indicators you're advised to install in the condensate discharge lines of your wet end dryers.

A glance will confirm the proper condensate flow or warn you of an inadequate flow. Nor need you fear that the "window" will cloud over and obstruct the view. It cannot cloud over.

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Such a program meets the individual needs of the executive and the practical profit-producing needs of the company, Mr. Pickus declared.

Executives should be developed and trained while they work, the speaker said. In many companies, he declared, it is impossible to send executives away for special training. An executive development program could be installed without taking the executive away from his office, he said. A staff specialist would be required to consult with the executives involved at monthly intervals.

Wet Strength

Although widely used for over a decade, wet-strength resins have only become known to the layman within the last year or two.

While a number of resins for imparting wet-strength properties to paper have been developed, the two most important are melamine-formaldehyde and urea-formaldehyde. Last year over 20 million lb. of them were employed for this purpose.

The first was urea. Back in 1935 a process of making wet-strength paper was introduced in which a water solution of urea-formaldehyde was applied as a surface size.

Then, in 1942, a process was developed involving the addition of water-dispersible melamine-formaldehyde resin to the beater.

The primary work was done by American Cyanamid Co. at its Stamford research labs where it found that the addition of melamine resin to paper pulp could (1) double the dry strength and (2) increase the wet strength fivefold. Since then, urea has also been adapted to the beater.

During World War II the largest consumer of wet-strength resins was the Army, which used them in combat maps and in the manufacture of V-boxes (which helped to replace lumber). In field tests, maps printed on resin-treated papers were soaked in water, wrung out, smeared with mud and grease, covered with paint and drenched in gasoline. The Army's conclusion: resin-treated maps were "useful and dependable under any circumstances."

Since the war, wet strength has become an important feature in the manufacture of many types of paper: absorbent, building, toweling, crate liners, curtains and draperies, multiwall bags, ice cube bags, posters, glassine, greaseproof paper, food packaging, locker papers.

How popular the feature will become is still anybody's guess.

Present uses include wet-strength snow fences, duck decoys, flower pots. At present all paper currency in South American countries and in Canada is resin-treated.

But the prairie-fire popularity of the resins may face this hurdle: some officials in the paper industry are wondering whether wet strength might not get out of control. A glance at a current trend explains why.

Today the largest consumers of wet-strength resins are industrial towels and multiwall bags. It's generally agreed that this efficacy in these fields is beyond dispute.

Now there's a trend to put them in paper napkins. Both Scott and International Cellucotton are test-marketing these, expect to go national on them soon.

Another trend is to put them in facial tissues. Scott has already added wet strength to its brand, Scotties, and television viewers are familiar with the water test. Queried on whether it will wet strength Kleenex, International says it has "no plans one way or the other."

In the meantime, most other makers of facial tissues are waiting to see what decision International will make. The reason: there are arguments for not adding resins to the tissues. To begin with, it is doubtful whether they make the tissues as absorbent.

What's more, there is one feature that seems in direct opposition to the theory of disposable tissues—when resin-treated, the tissues don't readily disintegrate, can clog up plumbing systems. The counter argument is tha tissues aren't normally disposed of that way and percentage of resin used (1/4 to 1/2%) is too small to

It will be interesting to see which viewpoint tr But of greater interest to the chemical industry is the two resins, urea or melamine, will come to domi wet strength field.

Today urea has the bigger share of the busines the huge promotion push Cyanamid is putting be melamines may change the picture. By getting say their products have been treated with Melos resin, it hopes to make the public as conscious of th mark Melostrength in paper as it is of Sanforized in

Cyanamid cites these advantages that melamine h urea (Cyanamid is the sole producer of the melamin

Greater resistance to acid hydrolysis. Quicke Nearly 80% as it comes off the machine. Urea is off 50%. Lower shipping costs. Melamine is ship powder form; urea comes in liquid form. Longer she as long as 5 years without deterioration, whereas ure to "gel" after 3 to 6 months.

The advantages of urea: Less expensive. Melami ages around 35 to 45¢/lb. Urea on a solid basis is arou Easier to use. The liquid urea-formaldehyde can be directly into the beater. Melamine must first be with acid and aged 4 to 8 hours. Broke from urea is problem. Because urea is slower curing, it's not the melamine is.

As a general rule, urea is used in papers where a low of wet strength is wanted, as in paper towels. W higher degree is needed, melamine is used. (Up to 3% into maps.)

The cost of adding the resins to paper varies becaus different percentages used but it's probably somewh tween 5 to 10% extra. In the case of multiwall comes to $4 to 5 more per thousand or about 1/2¢ ea bag. (Multiwalls sell for $100 to 105/thousand.)

Cyanamid sells eight wet-strength resins in all, wit varying from 10 to 48¢/lb. Four of these are urea.

Biggest of the urea makers is Rohm & Haas. It has resins, of which only one is a standard-type urea range in price from 7 to 10 1/2¢ on a wet-pound basis.

In the "advanced stages of development" is a fou will operate at a pH of 6.0, and "will be more effi lower concentrations." According to R&H, mos strength resins operate today at a lower pH than pap would like, usually 4.5. This low pH tends to red adsorption properties of the paper, also affects aging; it more brittle.

Hercules Powder, which claims to be the largest s of chemicals to the paper industry, has two ureas that used with a pH as high as 5.5. Reichhold has a "c range" of ureas, reports that January was a record for them. Allied Chemical and Dye Corp.'s Barret formerly Plaskon, has been selling one since 1950. makes a vinyl resin latex type. Borden has three latest develops "about 75% of its ultimate cure as th leaves the machine".

The collective opinion of urea producers is that it main top dog because melamine is more of an u quantity. Cyanamid, however, sees its competitors uring progress by how close urea comes to the stand by melamine.

Regardless of who wins, the public isn't going to loser. In one large city there is talk about making a homeowners to put in garbage cans. Not only would owners be spared the task of washing the cans, but garbage collector would be saved the trip he makes to the can.

Another suggestion is to put wet-strength resins i papers. Anyone who has picked up the Sunday pap

's been soaked with rain would urge the paper industry to
rry up.

ew Zealand Forest Products Ltd.

The first kraft paper to be manufactured from home-proced raw material was made at N. Z. Forest Products Ltd.'s ll at Kinleith when the paper mill went into operation on v. 14, 1953. Kinleith is in the heart of the company's 176,000 es of pine forests, mostly *Pinus radiata*, near the center of North Island of New Zealand.

The paper mill is the last part of a large integrated develop-nt scheme; its operation marks the final stage of this large erprise which has extended over a period of five years and cost, including a complete new townsite, some $6^1/_2$ million nds.

The paper mill is located near to the pulp mill from which it ives its primary raw material, namely kraft pulp. The rage capacity of the mill is 75 tons per day with a higher put on some grades; provision is made for a maximum out- of 100 tons per day by minor alterations to the plant at a r date. The keynote of the design of the mill has been ibility of operation; it is designed to produce a wide range kraft papers from lightweight wrapping papers to heavy-ght linerboard. At the same time the aim has been to ld a mill with a low capital cost consistent with efficient ration, the design being based on providing equipment st suitable for the carefully planned requirements and iding expenditure on items not immediately essential for se requirements. A large part of the output from the mill l go to the company's existing converting plants, including er sacks and fiberboard containers; the remainder will go eeting the requirements of the wrapping paper business ch has hitherto relied largely on imported paper.

lmost all the process equipment, and a large part of the lding materials, was obtained from the United Kingdom. consulting engineer on the design and construction of the per mill was S. E. Walmsley of Hitchins, Jervis & Partners London.

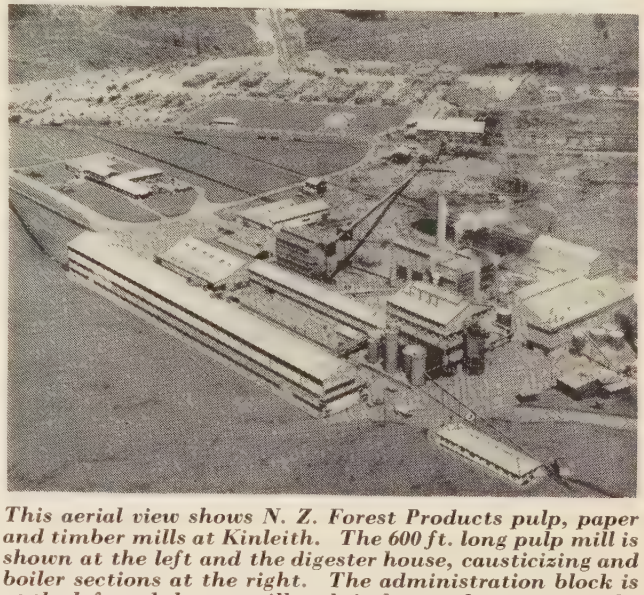
The paper mill plant is housed in a single building 576 ft. g by 63 ft. wide. A feature of the building design is the visions made to meet earthquake conditions; special de-ls were necessary, both on the superstructure and the ndations, to cover the seismic loading. Ecrofnier & tners Ltd. of London were associated with the consulting gineers on the reinforced concrete design. It is a basement pe mill, the paper machine being installed at the first floor el which is 14 ft. above the ground floor level; the total ght to the eaves of the building is 45 ft. above ground level. e provisions for seismic loading meant avoiding excessive r loads at a high level, this controlled the layout of some of plant and also involved special design on the isolation of ne of the unavoidable heavy loads at the first floor level.

The main superstructure of the building is structural steel-rk which was fabricated complete, ready for erection, in the ited Kingdom. The concrete bases for the steel stanchions connected by a system of heavily reinforced concrete ms. The walls are in reinforced concrete and asbestos eting, ample natural lighting is provided by continuous steel framed windows. The roof construction is asbestos eting on timber, the floors are in reinforced concrete with granolithic surfacing. The doors are mainly of the ged fireproof steel type. Large turnover type steel doors are vided at the main entrances to the mill.

The system of earthenware and concrete drainpipes dis-rge into the main effluent culvert which runs the full length he site and takes the effluent from the pulp mill and other ations on the site.

Road access is provided at both ends of the mill. At the er store end railway access is also arranged.

Primarily the paper mill operates on slush pulp; during those periods when the pulp mill is manufacturing a special grade of pulp for export or is otherwise not making the grade of pulp immediately required in the paper mill, lapped pulp from the pulp mill is used in the paper mill. Accordingly alternative arrangements are provided in the preparation plant to deal with either slush pulp or lapped pulp.



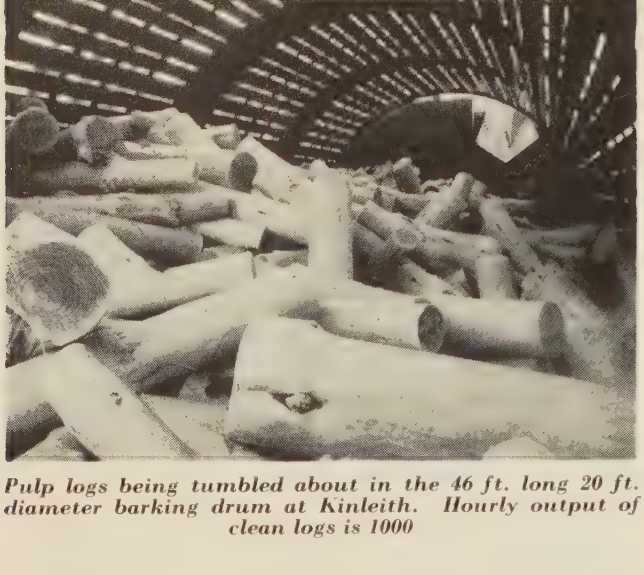
This aerial view shows N. Z. Forest Products pulp, paper and timber mills at Kinleith. The 600 ft. long pulp mill is shown at the left and the digester house, causticizing and boiler sections at the right. The administration block is at the left and the sawmill and timber yards at upper right

The slush pulp is pumped from the pulp mill to a buffer chest in the basement of the paper mill; from here it is pumped to a two-stage rotary gravity thickener arranged at first floor level, the pulp leaves the thickener at approximately 4% consistency and falls by gravity to the refiner chest. Provision is made in the basement of the mill for a small storage of lapped pulp, the lapped pulp is transported from the pulp mill by fork truck. The lapped pulp is fed by an inclined conveyor into an 18-ft. diameter hydrapulper, the pulp from the hydrapulper is pumped at a consistency of approximately 4% to the refiner chest. As the use of the lapped pulp is a secondary measure the hydrapulper is designed for batch operation but provision is made for conversion to continuous operation at a later date if required.

The pulp made by N. Z. Forest Products Ltd. is manufactured mainly from *Radiata* (*insignis*) pine. The use of this pulpwood results in a pulp with certain special characteristics and the preparation plant in the paper mill is designed to give the particular treatment required by these characteristics. The preparation plant is arranged at first floor level and consists of seven Morden Stockmakers and four No. 6 Miami jordans. Both the Mordens and jordans are interconnected in such a way as to give complete flexibility of operation, namely they can be run in parallel, series or any combination.

The pulp is pumped from the refiner chest to the Mordens and from here it falls by gravity into the machine chest. From the machine chest the stock is pumped to a refiner headbox which feeds the jordans which, in turn, deliver the stock to the machine headbox. Arrangements are made at the machine headbox for stock control to the machine.

All the stuff chests are arranged in the basement, under the preparation plant, and are of reinforced concrete design and equipped with propeller type circulators. The stuff and water pumps are of the centrifugal type. Provision is made for the close control of stock consistency at the preparation plant; a consistency regulator is arranged on the stock supply to the Mordens and a second regulator on the supply to the jordans.



Pulp logs being tumbled about in the 46 ft. long 20 ft. diameter barking drum at Kinleith. Hourly output of clean logs is 1000

The chemical plant is located in a separate section in the main building, the preparation being in the basement and the storage on the first floor. The size is made by the Deltherna process and the necessary caustic soda and rosin dissolving plant is installed. The chemical plant includes also the dissolving and storage equipment for alum. Provision is made for the future installation of other chemical plants, including the use of melamine and other resins for wet-strength papers, the preparation of starch mixtures for use at the paper machine calenders, and color plant. Space is provided in the basement for the storage of chemicals. The handling of chemicals to the preparation plant is by electric truck.

The supply of alum and size to the stock system is automatically controlled by a system of flow ratio controllers, the meter and transmitter being arranged in the stock line to the Mordens; the alum and size are introduced into the stock system at the machine chest.

The mixing pump delivers the diluted stock, at consistencies of 0.03 to 1.0% depending on the grade of paper being made, to two machine screens of the Lindblad type. From the screens the stock passes through a single-pass flowbox of special design into a projection slice and so on to the paper machine. Arrangements are made for by-passing the screens when operating on certain grades of paper.

The paper machine is of the fourdrinier type designed for a maximum finished trim width of 120 in. and to operate at speeds up to 1150 f.p.m.

The wire part is of the runout type, wire 138 in. wide by 90 ft. long; there are 27 rubber-covered table rolls, 15 in. diameter dandy and eight vacuum boxes; the suction couch roll is 30 in. diameter and is of the direct driven type; the top couch roll is arranged for automatic quick lifting; a high-speed shake is fitted; provision is made for adjustment of the slope of the wire. Draping gear is provided for wire changing and wire rope lifting gear is arranged in the roof.

The press part consists of two suction presses and a smoothing press. The suction presses are of the direct driven type, 28 in. diameter rubber covered; the top press rolls are granite 26 in. diameter; at the smoothing press the bottom roll is bronze 28 in. diameter and the top roll rubber-covered 26 in. diameter. Pneumatic loading equipment is provided for all three presses; vertical felt stretchers are arranged in the basement; felt conditioners are installed on each felt. Rubber marking equipment is arranged between the third press and the driers.

The dry part is arranged in four sections, there being four top and four bottom felts. There is a total of thirty-six 5-ft. diameter drying cylinders and eight 5-ft. diameter felt driers; the cylinders are designed for a working steam pressu p.s.i. Doctors are fitted on half the cylinders; all doc cluding those at the wire part, press part and calend arranged for oscillating, the necessary oil pressure being provided. The dry part is fitted with a mu steam and condensate circulating system.

There are two finishing calenders, the first a six-ro and the second an eight-roll stack. Motor-opera lifting gear is arranged and provision is made for the of pressure application gear at a later date; a system heated rolls is arranged; water doctors are fitted on stack for use when the machine is making water board. Two 5-ft. diameter after-driers are arranged b the two calenders.

The drum reel is of the pope type and is fitted wit derdamper.

Automatic rope feed is arranged for feeding the paper from the presses and through the dry part, also the after-driers; air feed is arranged at the couch, and the calenders.

The paper machine is driven by a d.c. sectional e interlocked drive which is powered by a motor gener with an output of 700 hp. The drive has eleven m tions, all section motors are standardized with a rate ity of 80 hp., two motors in parallel drive the couch a of the calender sections; one motor is installed for eac other sections. The drive as installed has a speed rang to 1000 f.p.m. but is designed for lifting the speed 1150 f.p.m. by slight modifications at a later dat electrical interlocking equipment consists of differenti lators and speed control is obtained by an Equiloc regulator. The whole of the machine drive equipm cluding the switchgear, is arranged in a separately annex in the main building.

The vacuum system for the paper machine consists tery of six Nash-type vacuum pumps arranged in t ment; special arrangements are made for silencers on charge from the vacuum pumps; a recirculation syst stalled for the sealing water to conserve the fresh water A system of Broughton controllers is arranged on t vacuum boxes.

A broke breaker is installed in the basement at th of the mill to handle all the dry broke from the mac the winder; as installed the broke breaker will wo batch basis but provision is made for conversion to co operation at a later date. The broke is pumped fr broke breaker to a broke storage chest; it is then pump the stock system at the machine chest as required. broke is collected in a sheet pit arranged under the co this also is pumped to the broke chest.

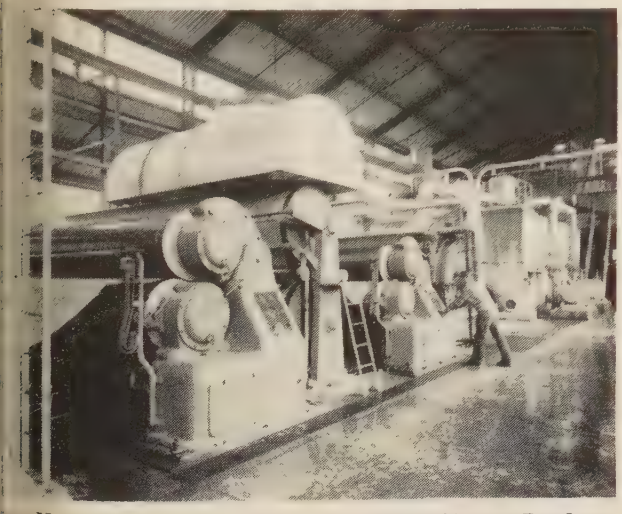
The backwater system is designed so that it can be c as a closed system or, alternatively, fresh water make be added at the wire pit. The white water from t trays is discharged into the wire pit from where it over a constant level into an excess water pit which, in tu charges direct into the backwater tank arranged un wire pit. The outlet from the wire pit is direct into a chamber where the thick stock is introduced and whic a suction chamber for the mixing pump. Alternate stock is added directly into the suction pipe of the pump. The main backwater pump supplies the ba from the backwater tank to the hydrapulper and to th breaker; a separate pump supplies, from the backwat the dilution water for the consistency regulators which through a constant level headbox. The filtrate from tank under the thickener is returned by pumping to t mill.

The whitewater from the wire vacuum boxes is dis from the Broughton system into a seal tank; this tan the spray pump which supplies all the shower pipes machine; surplus water from this seal tank is returne wire pit.

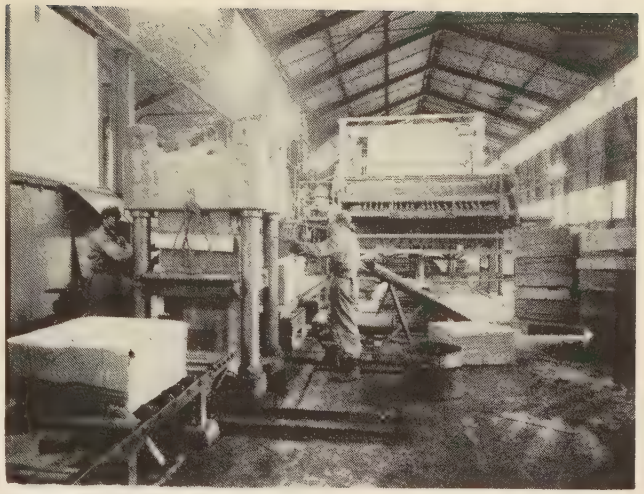
The dry part of the paper machine is fitted with an aluminum hood which is designed with a false ceiling and a system of dampers for controlling the distribution of air at the front and back of the machine. Vapor extraction from the hood is by four motor driven fans each with a capacity of 33,000 c.f.m.; the fans discharge into exhaust towers which pass through the roof of the building.

A hot air system is provided for the heating and ventilation of the building. Two fans each with a capacity of 50,000 c.f.m. supply the air for roof heating which is distributed the full length of the building by a system of ducts; dampers are fitted for local control of air distribution. This roof heating plant is arranged in a separate section of the main building at second floor level over the drive annex. Hot air is supplied to the basement felts on the dry part of the machine by a separate fan, with a capacity of 35,000 c.f.m., arranged in an enclosed section of the basement; this air supply passes through underground ducts and is distributed to the underside of the dry part of the machine by a system of metal ducts. The heaters for the air heating units operate on steam at 200 p.s.i. Pressure and automatic temperature control is provided. Special filters are arranged on the intake to the heaters; this is done to reduce the introduction of pumice dust into the building. Similar precautions are taken on all equipment drawing air from outside the building.

The process plant is provided with the necessary meters and instruments; the majority of the instruments are mounted on panels along the wall on the machine floor. Level recorders are installed on all chests and tanks; a complete set of instruments is provided for the main steam supply, the drying steam, the heating steam, and the fresh water supply; recorders are installed for the press loading equipment together with instruments for the vacuum system. On the paper machine a speed recorder is installed which incorporates also a basis weight recorder which is operated through a photoelectric cell. From the paper machine the reels of paper are transferred to the winder by an overhead electric crane. The winder is of the two-drum type with an operating speed of 3000 f.p.m. It is designed to produce finished reels of any diameter from 9 in. to a maximum of 42 in. and of any width from a minimum of 7 in. It is driven by a two-motor d.c. electric drive. Special provision is made for the handling of the trim from the edges of the reel; a pneumatic system of fan and ducting is provided to deliver the trim direct into the broke breaker. The finished reels are removed from the winder by automatic push-out gear on to an electrically operated lowering table. From the winder the reels are transferred on sunken trucks to a weighing machine. They then pass to a slat conveyor which passes along the packing floor and delivers the reels to a platform in the paper store.



The Kamyr uptaking machine in N. Z. Forest Products pulp mill at Kinleith



Baling sheets of dried kraft pulp for export to the Australian newsprint industry. N. Z. Forest Products Ltd. started shipments of about 1500 tons of pulp a month, beginning in August 1953

An 80-in. wide rewinder is installed to give flexibility of operation on the reeling of the smaller size reels.

The paper store is located at the east end of the main building and has a capacity of 800 tons of reels of all sizes. The paper is placed into the store by use of the overhead crane, the reels being handled in slings from the platform. The railway passes through the paper store and the reels are loaded by the crane into the railway trucks.

The electric power is supplied at 11,000 volts to three transformers located outside the main building at the west end; the high tension switchgear is located in an enclosed section of the basement of the building. The power distribution for the paper mill is at 400 volts, 3 phase, 50 cycles, and a main 22 cubicle switchboard is arranged at first floor level in the paper mill building at a point opposite to the preparation plant.

The total power load of the paper mill is approximately 3500 kva. Individual motor drives are arranged for all the items of plant; there is a total of 170 motors ranging from fractional horsepower to 700 hp. Synchronous motors are used on some of the larger units, including the paper machine drive, the Mordens and Jordans, for power factor correction in the system.

The fresh water supply to the paper mill is taken from the 32-in. diameter main which has been constructed over a distance of $5^1/_2$ miles to supply stream water for the whole of the requirements for the Kinleith operations.

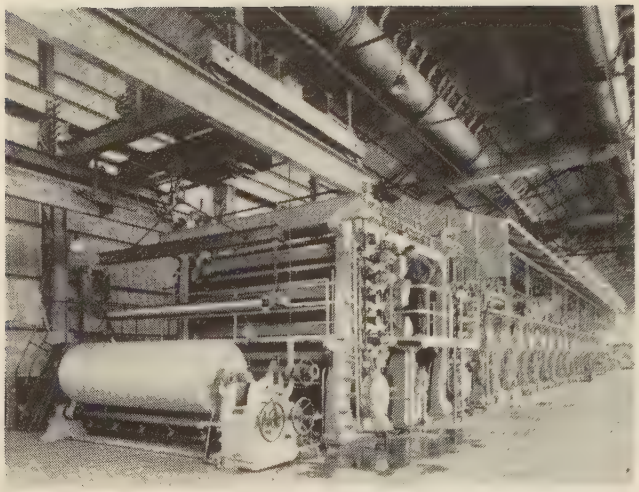
Steam is provided from the boiler plant in the pulp mill. It is supplied at a pressure of 200 p.s.i. This initial pressure is used for heating and miscellaneous services in the paper mill; the pressure is reduced to 50 p.s.i. for the paper machine drying. The total consumption of steam in the paper mill is approximately 45,000 lb. per hour.

A compressed air system is arranged in an enclosed section in the basement; this consists of two reciprocating type compressors supplying compressed air at a pressure of 120 p.s.i. for the paper machine and other miscellaneous services in the mill.

A special store is provided in an enclosed section of the basement for the stocks of wires and felts and other clothing for the paper machine.

Overhead cranes are provided in various parts of the mill. A 12-ton main all-electric crane is installed in the machine room and this also serves the roll store. In the paper store there is a 2-ton all-electric crane; separate cranes are also arranged in the drive annex, the clothing store and for reel handling at the winder.

The maintenance department for the whole of the Kinleith operations is centralized in the engineers' shops which were constructed with the pulp mill. In the main paper mill



The dry end of N. Z. Forest Products Walmsley paper machine at Kinleith. It has a trim width of 120 in., a wire 90 ft. long and is capable of speeds varying from 1000 to 1150 f.p.m.

building, between the machine room and the paper store, a roll store is arranged; this being provided for the storage of all spare rolls and other heavy equipment for the paper mill. The roll-grinding machine is installed in this roll store. This is designed to handle all sizes of rolls on the paper machine, including the drying cylinders. Provision is also made in this section of the building for a small fitters' shop and a sling store.

A core-winding machine and other equipment is installed for making the reel centers; a special store is provided in an enclosed section of the basement for storing these centers.

Fully equipped laboratories are provided in the paper mill for routine testing and control work. Well-equipped washrooms and other welfare services are arranged at various positions in the mill.

The following is a note of some of the machinery manufacturers and contractors who have supplied equipment for, or who have otherwise been associated with, this project.

Black Clawson International, Ltd., England, Hydrapulper and jordans, etc.
Blakeborough & Sons Ltd., England, valves
British Thomson Houston and Co. Ltd., England, motors and switchgear
Brown & Tawse Tubes Ltd., England, piping and valves
Carrier Ross Engineering Co. Ltd., England, heating and ventilating plant
Cellulose Development Corp., Ltd., England, thickener, etc.
Crompton Parkinson Ltd., England, motors and control gear
English Electric Co. Ltd., England, motors
Foxboro-Yoxall Ltd., England, meters and instruments
Fischer & Porter, U.S.A., chemical proportioning instruments
Harland Engineering Co. Ltd., England, pumps
Harland Drives Ltd., England, drives for paper machine and winder
Hopkinsons Ltd., England, valves
Mather & Platt Ltd., England, pumps
Metropolitan Vickers Elec. Co., Ltd., England, motors
Millspaugh Ltd., England, Mordens, etc.
Herbert Morris Ltd., England, cranes
Redpath Brown & Co. Ltd., England, structural steelwork
Saunders Valve Co. Ltd., England, valves
Shaw Glasgow Ltd., Scotland, cast iron piping
Shaw & McInnes Ltd., Scotland, cast iron piping
Vaughan Crane Co. Ltd., England, cranes
J. M. Voith, Germany, roll grinder
Walmsleys (Bury) Ltd., England, paper machine and some auxiliaries, winders, etc.
Wolstenholmes (Radcliffe) Ltd., England, valves

Hollingsworth & Whitney

A new bark-burning boiler has been completed at the Mobile, Ala., pulp and paper mill of Hollingsworth & Whitney Co. The boiler is a single-pass boiler with swaged tubes, built by Combustion Engineering-Superheater, Inc. acco specifications of Hollingsworth & Whitney. The boil building and accessory layout was designed and con and the boiler was installed by The Rust Engineerin Pittsburgh, Pa.

The new unit represents an improvement ov methods of burning bark for steam generation, bein the first of its type to utilize a new method of firing th practically complete combustion with minimum exces consequent high efficiency. Instead of pile or grate the bark is shredded and introduced to the furnace th high set spreader stoker. The bark is largely burne pension after passing through a zone of direct-contac rative drying. Turbulence nozzles inject air to help k bark in suspension, and the firing is under full automa trol.

Furnace consumption is estimated at 53,000 lb. per bark (at 50% moisture) in combination with natu When barking drums (supplying the bark) are not o the furnace is carried full load on gas. Oil can be u standby for the gas.

In firing, automatic controls base-load the boiler justing the natural gas to make up any deficiency in t that is available at any instant and proportion the tween bark and gas to burn both efficiently.

Design capacity of the boiler is 130,000 lb. per hr. when fired by bark, 160,000 lb. per hr. on gas, and lb. per hr. when fired by a combination of fuels o 100,000 lb. per hr. is produced by bark.

Ecusta

In 1937 the California Central Fibre Corp., a subsi Ecusta Paper Corp., located at El Centro in Cal Imperial Valley, began purchasing flax straw and sto it for future use by Ecusta. Only $7830 was s Imperial Valley flax straw that first year. In 1938 th flax growers received more than $28,000 for their fla but this was also stockpiled. Then in Septembe Ecusta began full time production of top-quality c paper made entirely from seed flax tow. Thus be new businesses—each dependent on the other—the s flax straw by the Imperial Valley flax growers and th facturing of fine flax papers by Ecusta.

The present relationship between Ecusta and the I Valley flax growers had its beginning in the early America was importing most of its cigarette pap France. Champagne Paper Corp. of New York, pre of Ecusta and one of the chief importers of the Frenc became concerned over the reliability of the paper from the foreign mills. Should a war break out in E and, with Hitler assuming control of Germany in seemed almost a certainly—cigarette paper imports w halted.

What to do? Build a cigarette paper mill in the States—yes. But the raw materials? The Frenc linen rags—why not import linen rags from Euro there was practically no linen industry of appreciabl the United States?

Again the question of supply came up, should a Europe break out. The only solution lay in finding able raw material, that could be found in abund America, to use as a substitute for linen rags.

Since linen is made with flax fiber, the most logical point in finding an American raw material was with t flax plant. Experiments were started in Estill, S. C the direction of W. H. Ramsey, Jr., now resident m and vice-president of the California Central Fibre C Ecusta subsidiary at El Centro. Several thousand fiber flax were cultivated but it was found that the of it for paper purposes was not economical and the w concluded in 1935.

While the fiber flax experiments were under way, L. F. Dixon, now vice-president and general manager of the Paper Division, was investigating the seed flax crop in America. Experiments had proved that seed flax fibers could be used satisfactorily, and left only the question of a source of supply. He found in California and in the Midwest, particularly in Minnesota, that seed flax was being raised on a large scale. The flax seed was being sold to linseed oil producers but the straw was regarded as waste and was usually burned or destroyed in some other manner.

It was discovered also that there were facilities in and near Minnesota for the production of fiber from seed flax straw. These facilities had been built to produce upholstery tow, a material used quite extensively in the manufacture of furniture during the early 1900's. However, due to the importation of better fibers from abroad, plus several other happenings, the sale of upholstery tow had practically diminished by the 1930's.

The owners of these facilities were glad, and understandably so, to have the opportunity to produce seed flax fiber for Ecusta. A few modifications in their process were necessary, but they were only minor.

In 1937, for the purpose of diversifying the company's activities, the California Central Fibre Corp. was formed, with Mr. Dixon as vice-president and Mr. Ramsey as vice-president and resident manager. The corporation built a flax processing mill in El Centro and began purchasing and processing seed flax fiber for shipment to customers, primarily, of course, to Ecusta.

Although not related to them, flax is very similar to the cereals—wheat, barley, oats, etc.—in its growing habits. In the Imperial Valley, flax is planted in the Fall of the year, around November 15, and is harvested during the latter part of May. In harvesting, the usual type of farm equipment is used, enabling the farmer who raises grain crops, in addition to seed flax, to get by without the additional expense of special flax-handling machinery. For example, the straw must be baled before it can be brought to the El Centro storage yard. This baling operation is accomplished through the use of typical pickup balers.

Farming in California is a vast and businesslike operation. Once maturity of a crop has been reached, harvesting proceeds on a strict and speedy time table. Such a program necessitates rapid handling of flax straw, the result being that in some years, as much as 25,000 tons of straw are received by the company within a 60-day period. This tonnage approximates 5000 truck loads, 650,000 individual bales, all of which is stored prior to processing.

The storage yard at El Centro covers approximately 100 acres. To keep the danger of fire to a minimum, the bales are arranged in stacks containing about 100 tons each. In addition, the stacks are spaced 100 ft. apart.

The processing at the El Centro mill is a year-round operation. The mill, a decorticating plant, is made up of machinery which roughly separates the fiber from the straw, eliminating a portion of the inner woody part of the flax stalk, known as "shive." The machinery consists, basically, of a series of paired, corrugated rollers. The flax straw is fed between upper and lower rollers which crush the stalk and allow the shive to fall beneath the machine where it is removed by a dragline. Following this separation, the resulting fiber is baled in tightly compressed bales, loaded in boxcars and shipped to Ecusta and other customers.

In Minnesota the flax scene is similar to that in California. The notable difference is in the flax growing area. Flax areas extend over practically the whole state of Minnesota, resulting in that state's having a larger flax acreage than California —since flax is grown there in a relatively small area. The straw concentration problem is considerably more difficult than in California, and, too, in the Midwestern area the straw must be dried before processing.

The seed flax straw industry may be looked upon by the individual Imperial Valley farmers as no more than a "sideline business"—a means of picking up a supplementary income from their flax crop. But when the purchases by California Central Fibre from individual farmers are combined, it no longer appears a "sideline business." In 1951 the flax growers received $345,426.53 for their flax straw—more than 44 times as much as they received 14 years before. By the end of the 1952 season the corporation had paid to the Valley flax growers approximately $3,750,000 for flax straw since the first purchases in 1937.

S. D. Warren

Cumberland Mills, S. D. Warren Co., located on the Presumpscot River at Westbrook, Me., is 100 years old, having begun operations at this location in 1854 as a rag paper mill of $1^1/_2$ tons per day capacity.

Many cycles of expansion and modernization over the century have transformed this modest beginning into a mill that today has a daily capacity of 240 tons of hardwood soda pulp and 40 tons of pine soda pulp. This pulp is used to manufacture 450 tons per day of plain and coated finished papers.

Cumberland Mills is a "book mill," specializing in the production of high grade papers for advertising brochures and catalogs, and it has the distinction of having made the first coated paper produced in the United States.

The latest step in the most recent cycle of plant modernization consisted of complete replacement of the soda mill's pulp washing, screening, and bleaching facilities, with expansion of capacity for filtering process water; and the addition of an oil-fired rotary lime kiln to the causticizing cycle.

The rotary kiln measures 102 in. and 108 in. diameter by 170 ft. long and has a handling capacity of 75 tons of kiln product per day, based on being fed precipitated calcium carbonate in the form of a slurry containing approximately 45% moisture.

The fuel consumption per ton of kiln product is approximately 10,000,000 B.t.u.

The burned lime, normally discharged from kiln in lumps of $^1/_2$ in. and under, at a temperature of around 1800°F., is conveyed to an agitated primary slaking tank and then pumped to a conventional lime slaker.

The Link-Belt conveying medium from the lime kiln consists of an inclined overlapping steel apron conveyor, 24 in. wide by 22 ft. long, and a vertical steel-encased centrifugal discharge bucket elevator, 30 ft. high, for receiving the hot lime from apron conveyor and delivering it to primary slaker.

Conveyor apron has overlapping steel side plates to confine the material and is provided with readily removed sectional covers in carrying run in order to confine the heat and provide greater safety.

Conveyor apron is mounted on two endless strands of rugged bar steel roller chain equipped with 4-in. diam. single flanged Flint Rim rollers every second pitch, mounted on through rods tying the two strands together, and riding on T-rail tracks in both runs. Rollers are fitted with case-hardened steel bushings.

Chute to foot of bucket elevator is provided with a grizzly to screen out any oversize lumps encountered occasionally and discharge them to floor.

Bucket elevator is equipped with 12 by 7-in. malleable iron style "A" buckets secured at intervals to a single strand of class "C" malleable iron and steel elevator chain.

The head of elevator has a two-way discharge chute, whereby it is possible to by-pass the primary slaker and deliver the burned lime to a horizontal 9-in. diam., 13-ft. long screw conveyor discharging into a secondary slaker.

Pebble lime from a previously existing storage bin is measured out through an automatic feeder into another Link-Belt screw conveyor delivering into the secondary slaker.

The latter screw measures 12 in. in diameter by 27 ft. long and is installed on an incline of 20 degrees.

The Link-Belt apron conveyor, bucket elevator and two separate screw conveyors have a designed handling capacity of 120 tons per day, and each is operated from a separate motor through a Link-Belt Motogear and enclosed RC precision steel roller chain drive.

J. E. Sirrine Co., Greenville, S. C., were the engineers on this lime-burning project. The results achieved are greater capacity and lower cost of causticizing.

Crossett

During fiscal 1953, Crossett Paper Mills, Crossett, Ark., produced and sold 136,984 tons of paper. This represents a production increase of approximately 10% over 1952. Of the 1953 tonnage, 34,549 tons were sold to paper merchants and 102,435 tons to paper converters. 271,371 cords of pulpwood were consumed by the mill during the year.

On the same plane, if not on a higher plane, as the production record was the plant safety record. 1,615,217 man-hours were worked without a lost time accident and a full year was worked with only one lost time accident.

New assignments in plant management were extensive. Paper mill superintendent R. W. Burnett, resigned in September to accept a new position. W. B. Jenkins, who was assistant superintendent, was elevated to take over the vacant position and A. W. Duskin and A. G. McCaughan were made assistant superintendents with Roy Collins moving up to tour foreman.

To fill further vacancies created by these promotions, E. H. Smith was promoted to technical service director and C. L. Brown to assistant. In the Sales Department, Don Hodge was named executive assistant to the sales manager.

In the field of plant modification and expansion, much was accomplished during the year. Two new digesters and automatic cooking controls were added in the pulp mill and a fourth stage washer was installed. Additional felt driers were added to the paper machines. Work was started on the installation of Vortraps and a breaker stack on no. 1 Machine. In addition, construction was begun on a new bark boiler, pulpwood storage pond, and on the new bleached board mill.

Construction of the new mill is under the supervision of D. B. Kuhe with J. E. Sirrine Co. of Greenville, S. C., in an engineering and advisory capacity. This mill represents the first step of The Crossett Co. in the production of hardwood pulp and its conversion into quality board. By the end of 1953, long strides had been made in engineering and clearing of the mill site had begun.

Time

In December, 1952, Time, Inc. joined with Houston Oil Co. in organizing the East Texas Pulp and Paper Co. to construct and operate a pulp and paper mill in Evadale, Tex., near Silsbee, some 15 miles from Beaumont.

During 1953 it was decided to increase the mill's planned capacity from 250 to 300 tons per day of bleached sulphate pulp and paperboard, resulting in an increase from approximately $25,000,000 to $27,500,000 in the mill's estimated total cost. When completed, it is expected to have an annual rated capacity of 100,000 tons.

Olin

Olin Industries, Inc., East Alton, Ill., plans the erection of a new cellophane plant, to be located at Kern, Warren County, Ind., on the Wabash River between Covington, Ind., and Danville, Ill. It is estimated the new plant will double the productive capacity of Olin Cellophane. Olin now manufactures cellophane at Pisgah Forest, N. C.

The cellophane plant at Kern will be designed and constructed by E. I. du Pont de Nemours & Co. under the terms of a contract made in November, 1949, whereby Olin purchased the right to use du Pont cellophane paten technical information and secured du Pont's agreen design and construct two cellophane plants.

Mando

Minnesota and Ontario Paper Co. had a record-b production and sales year during 1953. Net sales were $67,331,489. Notwithstanding a continuation o costs, earnings of $5,687,358 were higher than in 1952.

The company's eight paper machines and its pole, lumber ment, its four Insulite machines and its pole, lumber making and treating facilities turned out forest produc record-breaking rate last year. Paper production r 283,536 tons; Insulite production hit 455.6 million feet, and National Pole produced or treated more t million lineal feet of forest products.

During the year, several new products were dev As the result of the modernization of no. 3 paper m two new bleached groundwood papers, Mandoset and M web, were introduced. Insulite developed a flame-re finish for many of its interior boards and a new acousti was devised and placed on the market. Insulite Roo was also developed during the year.

The company's modernization program continue steady rate. Modernization high lights of 1953 inclu rebuilding of no. 3 paper machine at International Fa no. 5 paper machine and the $5 million grinder roo power facilities projects at Fort Frances. Among other betterments were the installation of a heat re unit at Kenora and improvements to Insulite screening ties at International Falls.

Of interest in forest management was the establishme Timber Management Service for small landowners a adaptation of IBM techniques to forest lands inve providing important new data on our future wood sup

National Vulcanized Fibre

National Vulcanized Fibre, Wilmington, Del., has sig agreement to acquire all outstanding stock of the M Bros. paper mill at Yorklyn, Del., making Marshall F wholly owned subsidiary of National.

The development serves to cement a long-existing ing relationship between the two companies. Sinc the entire paper output of Marshall Bros. has been u by National in the production of vulcanized fiber, Ph laminated plastic, Vul-Cot wastebaskets, and ma handling equipment.

National plans a modern research laboratory to e the facilities of the company's research and develo section.

St. Regis

St. Regis Paper Co. has selected a 21-acre prope Franklin, Va., as the site of its new multiwall bag ma turing plant. The new plant to be occupied by St. under a long term lease, will replace the one presently from the Camp Manufacturing Co. in Franklin. The Co. requires the leased plant for its own expanded oper

Construction of the new facilities, which will p 160,000 sq. ft. of space, is to start in the near future. new structure will have facilities for four tuber lines, p and engraving, paper and bag storage, and general off

St. Regis also plans to proceed with a new plant Bucksport, Me., mill for the peroxide bleaching of su pulp. The new bleach plant will expand the capacity mill to a level that will permit bleaching of its full o Cost of the new facilities will exceed $600,000.

During the year, St. Regis produced 486,000 tons o paper and board, compared with 351,000 tons in 1952. 38% increase resulted from the starting of the new Ja ville mill, plus increased production at Pensacola fro new paper machine that started up in the first quarter o

Since April, 1952, St. Regis has brought into operation new productive capacity of 200,000 tons per year of kraft paper and board at the Pensacola and Jacksonville mills. With this new capacity, the company has now become a major producer of kraft paper and board.

The new Jacksonville mill started production in January. Output included a large tonnage of corrugating and liner boards. The paper machine is being modified so that in addition to heavy boards it can produce lightweight kraft papers.

Equipment at the Jacksonville mill is as follows:

Woodyard

Barking: 2—12 × 45-ft. 2-section U-bar type barking, drum by Fiber Making Process. 1 bark hog—Mitts & Merrill.

Chipping: 2—88-in. Murray 10-knife chippers, 400 hp., 705 r.p.m. 4 link belt vibrating chip screens. 1 reject chipper—Murray.

Wood handling: 3 cranes—1 locomotive type, 2 crawlers. 1 payloader, 1 Bantam half track crane.

Pulp Mill

Chip storage: 3 silos on ground level (860 cords total). Link Belt rotary plate feeders. 42-in. chip conveyor belt equipped with lightometer.

Cooking: 4 digesters, 4000 cu. ft. each. 13.5 tons/digester yield. 2.5 hours cooking time. 110 p.s.i. cooking pressure at 344°F. Forced liquor circulation without heaters. 7700 active alkali per cook. 11,400 gal. total liquor volume per cook.

Washing: Impco preknotters. Impco vacuum type washers, 3 drums, one line, 11.5 × 16-ft. face. Washed pulp contains approximately 15 to 20 lb./ton salt cake. First stage filtrate, black liquor solids to the evaporator, 16.5%.

Screening: 22 Impco plate flat screens (16 primary and 6 tailing in lines of 2 screens each). 0.020 in. cut primary, 0.016 in. cut secondary, and 0.014 in. cut tailing. 1 Bauer refiner for rejects, 36 in. double disk. 2 Impco deckers, 8 × 12-ft face. 36-in. high density belt conveyor. 2 high density storage silos, 300 tons at 14% consistency capacity of each. Stebbins tile.

Refining Equipment

Primary: 2 lines of Victory beaters with 4 rolls each line.
Secondary: 4 Emerson jordans. 1 Oliver saveall.

Paper Machine

General: Paper grades manufactured 30 to 90 lb./ream. Daily average—350 tons/day. Record—504 tons. Board grades manufactured 78 to 162 lb./ream. Beloit machine installed in 1952 began operation Dec. 31, 1952. Machine drive by General Electric. 2500 f.p.m. designed speed. Record speed—1850.

Headbox: Pressurized-constant liquid level of 32 in. maintained for average flow conditions. Fan pump, Worthington 450-hp., G.E. synchronous drive.

Fourdrinier: Wire 230 in. wide by 120 ft. long. Breast roll 42 in. in diameter. Stainless steel foaming boards with St. Regis Duralyte blades and mounting. 44-in. diam. couch roll. 8—14-in. suction boxes and 2—10-in. suction boxes.

Presses: Beloit pickup arrangement. 3 wet felts, main, pick-up, and inverse. All suction roll, 36 in. diam. Top rolls, 32 in. diam. and interchangeable. Breaker stack, 32-in. diam. rolls. Size press, 32 in. diam. rolls.

Driers: All driers 60 in. diam. each, 71 paper driers with 18 felt driers arranged in 4 sections. Machine has 6 drier felts, 165 p.s.i. steam is utilized for paper drying.

Calenders: 2 stacks with starch system and water boxes on first stack. 1—60-in. diam. drier between stacks. Reel drum diam., 36 in., built by Beloit.

Winder: Beloit, 220 in., equipped with collapsible core and lowering conveyor for rolls.

Broke handling: 1 Hydrapulper, 18 ft. Shartle-Dilts.

Evaporators & Recovery

Evaporator: 1 sextuple effect six body Goslin-Birmingham, built in 1952, capacity of 192,500 lb. per hr. evaporator. Per cent solids from discharge at last effect 50–53%.

Recovery: 1 C.E. recovery unit producing 134,000 lb. steam per hr., burning 900,000 lb. solids per 24 hr. 625 p.s.i. operating pressure at 750°F. 2 Koppers precipitators remove 98% of gas dust, 132,500 c.f.m. gas capacity.

Lime Kiln & Causticizing

Lime Kiln: Traylor 9 ft. diam. by 175 ft. long. Capacity of 300 tons lime/day. Oliver mud filters, 6 ft. diam. by 8 ft. face.

Causticizing: Dorrco slaker—3 reactors, G.L. clarifier, W.L. clarifier, dregs washer and mud washer.

Boiler Room

Power: 1 power boiler C.E., steam production 160,000 lb. per hr. Fired by fuel oil Bunker "C" type, operating pressure, 625 p.s.i. at 750°F.

Bark: 1 bark boiler C.E. suspension type with traveling grates, ash hopper, and dust collecting cyclone. Production 135,000 lb. steam per hr., operating press 625 p.s.i. Graver hot lime water softener, with ion exchangers.

Turbines: 2—G.E. 7500-kva. generators—1 condensing and 1 extracting.

St. Regis has three wholly owned subsidiaries which operate multiwall bag plants in Belgium, Brazil, and Argentina. These companies convert Scandinavian kraft paper, or paper made locally from imported pulp. St. Regis also has minority interests in, and technical aid agreements with, bag manufacturing companies in Australia and Colombia.

In addition to these manufacturing activities abroad, St. Regis has technical aid agreements with 13 licensees who manufacture multiwall bags for sale in a number of other countries in Europe, Africa, Central and South America, and the East Indies.

In November, St. Regis announced the sale of the paper mill at Harrisville to a newly formed company, Harrisville Paper Corp., which is operating it. This mill had two paper machines with combined productive capacity of 20,000 tons per year of groundwood specialty papers. A portion of Harrisville's production was transferred to other mills of St. Regis at Bucksport, Me., and at Carthage and Herrings, N. Y.

A firm market demand for multiwall bags carried through 1953, and St. Regis increased its production of bags slightly over the year before. Prices for multiwall bags remained unchanged until the end of the year, when advances were announced by the company, to be effective Jan. 1, 1954.

The Pensacola bag plant expansion was completed in March and the machinery was in operation by September. The additional floor space not only permitted installing more equipment, but also rearranging the machinery, conveyors, and storage and shipping facilities for more efficient operation. The plant produces all types of multiwall bags, as well as small bags for sugar and potatoes.

In mid-summer the new plant at East Providence, R. I., for manufacturing bag-filling and bag-making machines was completed, and equipment was moved from the former plant at Oswego, N. Y. This new plant provides more floor space and better manufacturing facilities. It includes a fully equipped machine shop, testing laboratory, experimental laboratory, engineering and general offices.

The new semirigid container, which has been under experimentation and field testing for several years, was commercially adopted in 1953 in the flour milling industry. This is a single-wall bag made of special paper board, replacing the carton in which 2, 5, and 10 lb. bags are ordinarily placed for shipment. In order to facilitate filling this container, a baling machine has been designed and manufactured by St. Regis which packs the small bags tightly in it.

Toward the end of the year, the company established a Multiwall Packaging Division, thereby unifying its sales and field engineering organizations throughout the country.

The economy of Canada continued to expand in 1953 and St. Regis Paper Co. (Canada) Limited increased the production of its bags, required in the country's enlarged business activity.

The Cap de la Madeleine bag plant and the Dryden bag plant both increased their production over 1952, and the Vancouver plant converted all paper available to it. As a result, the company increased its total sales and earnings over both 1952 and 1951, which was the previous peak year.

I.P.

A new converting plant for the production of Pure-Pak paper milk containers will be opened this Spring in Pelham Manor, N. Y., by the Single Service Division of International Paper Co.

Located at 5 Penn Place, the new plant will occupy ap-

proximately 32,000 sq. ft. and will employ approximately 25 people when it is first opened. Plans call for a modern brick and steel building designed to provide attractive and completely sanitary working conditions. Much of the manufacturing area of the single-story building will feature tiled walls and the floor design and equipment layout will be planned to maintain the highest standards of cleanliness.

D. D. Milsom, formerly manager of the Single Service plant in Atlanta, Ga., has been named manager of the new Pelham plant and W. J. Andrews will be superintendent.

From nurseries such as this one at Munson, Fla., International Paper Co. last year distributed 30 million pine tree seedlings. Nearly half of these were given away free to small landowners to encourage tree farming and stimulate forest conservation, while the remainder were planted on company lands to help nature replace recent cutting operations

Thirty million pine tree seedlings were distributed by International Paper Co. during the 1953–54 planting season and even more will be given out this year. This program resulted in 42,000 new acres being put into timber production during the year. Of the 30 million seedlings distributed, nearly half were given free of charge to small landowners and schoolboy groups throughout the southern states, while the remainder were planted on company lands.

Scott

Scott Paper Co. has enjoyed a strongly consistent growth record with few parallels in American industry. Paper product sales increased 140% from 1927 to 1937; 312% from 1937 to 1947; and 160% from 1947 to 1953 (estimated). Over this 26-year period sales declined (in each case moderately) in only three years—1932, 1933, and 1943. The company has operated at a profit in every year since 1920.

Scott manufactures and sells toilet tissues, roll and folded paper towels, facial tissues, household wax paper, paper napkins, industrial wipers, and wood pulp.

Scott's acquisition by merger in 1951 of Soundview Pulp Co. in Washington brought to the enterprise substantial high grade pulp capacity and important timber reserve made possible finished paper facilities on the West

History

The company had its origin in Philadelphia as a p ship about 80 years ago. In the early years it went t progressive stages as commission merchants in pape agents for various types of wrapping paper, and as converters of toilet tissues. The latter business in the purchase of parent rolls of tissue which were cut and packaged for others under their private labels. enterprise was small and barely weathered several c sions. In 1910 Scott purchased two papermaking ma thus freeing itself for the first time from total reliance manufacture of others. These machines were instal an existing plant at Chester, Pa., acquired for the pu This location was selected because rail and water trans tion were good, the process water supply adequate, Ph phia nearby, and the plant reasonably available to B New York, Baltimore, and Washington. Nearly ha population of the country was within a 500 mile radius

In 1913 the company took the important step of giv the private label business completely and selling its under its own brand names exclusively. It had been its own toilet tissue under the name "Waldorf" sinc (the name having been purchased from a former cust and its own paper towels since 1907. Entry into the towel business seems to have come about because the learned that a Philadelphia school teacher, with an improved sanitation in the school washroom, had been c up pieces of paper to supplant the unsanitary cloth then generally in use. Scott, as it happened, had re from a supplier some paper which was too heavy for tissue. The ScotTissue towel was thus born, and th took hold unexpectedly well. The original product course not comparable with the high quality product manufactured today.

In 1911 the third papermaking machine was install in 1913 the fourth. In 1914, the first full year after ab ment of the private label business, sales reached $1,0 for the first time, about equally divided between toile and paper towels. By 1920 net sales had reached $2.7 and have continued to expand, with only minor interr to the present time. In round figures, finished paper uct sales have gone from $5,800,000 in 1927 to $8,0 in 1932, $13,800,000 in 1937, $31,900,000 in 1942, $57,3 in 1947, and $129,200,000 in 1952. Plans for the c year call for finished paper product sales of more than 000,000, and the company's president has announced of $300,000,000 for 1958.

By 1927 the original four paper machines had all b placed by modern units. The last three produced 175 in. wide at speeds of 600 f.p.m. or better, conside the trade as mechanically impossible at the time. succeeding 10 years two existing machines were repla new units, two additional machines were installed, a of the remaining six units were rebuilt to conform to im methods continuously being developed by the Scott neering staff. In 1937 the company was operating s chines of latest design producing paper of the highest at speeds which set the pace for the industry.

From 1937 through 1939 three more modern machine installed, one complete unit being designed especially manufacture of paper towels. At about the same time power, and storage facilities were substantially enlarg

Up to 1941, the company's paper manufacturing a ishing facilities were confined to its Chester Plant. I year a subsidiary, Marinette Paper Co., was form purchase from International Paper Co. plants at Ma Wis., and South Glens Falls, N. Y. These purchases it possible to expand towel and toilet tissue production enter the facial tissue field. In 1944, Marinette

nother plant from International Paper at Fort Edward, N. Y., a few miles down the Hudson River from Glens Falls. The productive capacity at Fort Edward has been substantially increased by the installation of two new high-speed papermaking machines, by the rebuilding of one of the three original machines to incorporate the high speed principles of the new machines, and by the installation of modern finishing equipment necessary to convert the entire output of this mill.

In 1945 the business and assets of Automatic Paper Machinery Co., Inc. were acquired in exchange for 136,840 Scott common shares. This acquisition added the well-known Cut-Rite household wax paper to the Scott line, with substantial sales which have considerably more than doubled since the date of acquisition.

In early 1951 the company purchased the capital stock of Falls Paper & Power Co. for 30,000 of its common shares. This added to the enterprise a plant in Wisconsin with a bleached sulphite pulp capacity of more than 25,000 tons per year and two relatively small papermaking machines which have been improved and adapted to the manufacture of Scott products.

In November, 1951, Scott made the most important move in its history when Soundview Pulp Co., Everett, Wash., was merged into Scott. This brought into the enterprise one of the finest pulp mills in the country backed up by extensive stands of high grade timber, and a means of realizing a plan for a Pacific Coast paper mill long in the minds of the Scott management.

Scott has used progressively more of the Soundview pulp output in its own operations and at the present time is using about 50% of it. Through improvements in the mill operation, Soundview's pulp production has been built up to approximately 615 tons per day, and a program is under way to increase the daily rate to a figure of over 700 tons.

Pulp Supply

Although Scott had invested in a relatively small pulp operation in Canada as early as 1923, it was not until 1936 that the company took steps toward substantially increasing its integrated pulp supply. In that year Brunswick Pulp & Paper Co., Brunswick, Ga. was organized by the company and The Mead Corp., each of which has a 50% stock interest representing a present investment of $3,564,000 for each of the owners. Brunswick constructed a sulphate pulp mill with an original rated capacity of 150 tons per day. It began operations early in 1938, and has since increased its daily rated capacity to more than 450 tons of high grade bleached sulphate pulp. Substantial stands of timber back up the operation. Scott is entitled to the production during one half of the pulp mill's operating time, and expects to secure approximately 80,000 tons of pulp from this source in 1953.

Additional sources of pulp were obtained in 1940 through the acquisition of two unbleached sulphite pulp mills in Oregon and Washington which are operated by Coos Bay Pulp Corp., a wholly owned subsidiary. It is expected that these mills will supply about 62,700 tons of pulp in the current year.

Nairn Falls Pulp Co., Ltd., of Clermont, Canada, operates pulp grinding and bleaching equipment owned by a Scott subsidiary, under an arrangement running through 1961 which will provide Scott with about 14,500 tons of bleached mechanical pulp this year.

Marinette Paper Co., another subsidiary, has at its Marinette, Wis. plant, production capacity for about 20,000 tons of bleached sulphite and groundwood pulps per year.

Falls Paper & Power Co., also a subsidiary, has bleached sulphite pulp producing capacity of about 25,000 tons per year at its Oconto Falls, Wis., plant.

Production of the Soundview operation was about 215,000 tons of bleached sulphite pulp in 1953, about 50% of which was consumed by Scott and the balance sold to others. With the Soundview paper mill in operation, and as the second machine comes on the line this year, Scott will use more of this pulp. The project for increasing Soundview's pulp-making capacity will provide additional tonnage approximating the estimated bleached sulphite pulp requirements for the two papermaking machines at Everett, and the company plans to continue selling a portion of its pulp output to others.

CHARMIN

Charmin Paper Mills, Green Bay, Wis., has construction of its torula yeast plant well under way. The plant is designed to process all of the spent liquor from Charmin's sulphite pulping operations.

STRATHMORE

Albert W. Dempsey has been appointed superintendent of the Keith Paper Co. division of Strathmore Paper Co. in Turner Falls, Mass. William C. Bryan has been made assistant superintendent of Strathmore's No. 2 mill at Woronoco, Mass., and Robert E. Hosmer is now assistant superintendent of the West Springfield, Mass., mills.

KVP

Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich., has installed a 32 by 52-in. Cottrell six-color rotary letterpress for use on wrapping papers. The new press is equipped for pre-makeready, has electronic tension control, and a Scan-a-web with 6-power telescope.

RAYONIER

Donald R. Walton has joined the sales department of Rayonier Inc., as a technical service representative.

NEPCO

E. P. Gleason, manager of outside power for Nekoosa-Edwards Paper Co., Port Edwards, Wis., retired March 1 after more than 41 years of service.

NEPCO's outside power division has been combined with the mill power division in one central power department, with Frank H. Coldwell as manager.

GAIR

R. Thomas Hanger has been appointed manager of the Teterboro, N. J., division of Robert Gair Co., and Arthur J. Brewster has been named manager of the Angelus Box division at Los Angeles, Calif.

GLATFELTER

Philip H. Glatfelter III has been elected president of the P. H. Glatfelter Co., Spring Grove, Pa. Mr. Glatfelter succeeds his father, who had been president for 25 years, and who will continue active in the company as chairman of the board.

SEWERAGE PLANT OPERATION

The General Extension Division of Louisiana State University has published Engineering Experiment Station Bulletin No. 41, containing the proceedings of the 16th annual short course for water and sewerage plant superintendents and operators, 1953.

PLASTICS EXPOSITION AND CONFERENCE

Sponsored by the Society of the Plastic Industry, Inc., the 1954 Plastics Exposition and Technical Conference will

P. H. Glatfelter III, P. H. Glatfelter Co.

be held June 7–10, 1954 at the Public Auditorium, Cleveland, Ohio.

Western Michigan

Western Michigan College of Education is planning a scholarship in paper technology in honor of L. H. Breyfogle, a veteran of 70 years in the paper industry. Contributions to the Breyfogle fund will be welcomed by the college.

Western Michigan's 12-week evening lecture series on "Coating Methods and Equipment," sponsored by the paper technology department, is being attended by 158 persons.

Forest Products Laboratory

The U. S. Forest Products Laboratory, Madison, Wis., has developed a method of upgrading common lumber by gluing a sheet of resin-soaked paper to each side. In addition to giving the lumber a smooth, weather-resistant, unblemished surface, the impregnated paper gives the lumber greater dimensional stability.

Gaylord

A milestone in reforestation in the United States was reached on Feb. 18, 1954, when the number of pine tree seedlings planted by Gaylord Container Corp. on its tree farms in Louisiana and Mississippi reached one hundred million. The actual planting site was Millard, Miss.

The one hundred millionth seedling was planted by J. K. Johnson, under whose direction, as forester for the Great Southern Lumber Co., the reforestation program wa back in 1920. He was assisted by Mary Easton Go ten year old granddaughter of C. W. Goodyear, fir president of Gaylord Container Corp., and great daughter of one of the two founders of the Great S Lumber Co. A. Conger Goodyear, chairman, Board o tors, E. J. Spiegel, president and Vertrees Young, ex vice-president of Gaylord Container Corp., also took the program.

Planting the 100 millionth tree in Gaylord Container Corp. man-made forest. Left to right: A. C. Goodyear, New York, Chairman, Board of Directors, Gaylord Container Corp.; J. K. Johnson, Bogalusa, La., retired, former Chief Forester, Great Southern Lumber Co.; Miss Mary Easton Goodyear, Bogalusa, La., great granddaughter of one of the two founders of the Great Southern Lumber Co.; and C. W. Goodyear, Buffalo, N. Y., First Vice-President, Gaylord Container Corp. Forester Johnson supervised the planting of the first tree in the original reforestation project of the Great Southern Lumber Co. Total area of the Gaylord man-made forest is now 110,500 acres

The site of the event was previously occupied by a which many years ago closed down because it had ex the supply of timber in that area. Adjoining the site is a two-year-old slash pine plantation—part of G current reforestation program.

The reforestation work began in 1920 as part of a in the minds of the founders of Bogalusa, Charles Frank Goodyear, when the town was built around of the gigantic new sawmill of the Great Southern Co. From the very start, the town was carefully for permanence and growth as distinct from the avera mill towns of those days whose life was deemed con with the supply of virgin pine timber. While the ne could not save the sawmill, which closed in 1938, th Southern had established a worthy successor in the fo pulp and paper mill, which began production in 1918.

Since 1937, the reforestation program has been oper Gaylord Container Corp. due to a merger that year the original lumber company and Gaylord interests.

To appreciate the far-reaching importance of the decision to adopt a tree planting project, it should be that in 1920 there were no large commercial planta forest trees in the United States. Aside from some derived through the sale of Christmas trees, the pro sibilities of tree farming were not even considered.

Starting with 800 areas, on which pine seeds were the trail-blazing experiment in industrial forestr through a period of trial and error. The sowing of superseded by the transplanting of wild pine seedling to high costs, this in turn gave way in 1922 to th seedlings grown in the Great Southern Lumbe nursery at Bogalusa. Fire was a constant threat, bu back hogs, with a sweet tooth for the succulent roots o pines, were also a menace and made it necessary t the planted tracts.

Mechanization has found a place in the program. nine-month old seedlings are placed in the ground by a planting machine with a crew of two men, capable of 10,000 seedlings per day. Depending upon soil produ and other local factors, the pine trees attain usable pu size (for a first thinning) at an age varying betwee and eighteen years.

National Container

National Container Corp. has acquired "more tha of the outstanding capital shares of Seaboard Containe one of the leading corrugated paper shipping box facturers in the eastern United States, with plants at Pa., and Newark, N. J. Seaboard also operates paper mill in Reading, Pa. Announcement of the acc was made in a joint statement issued by Samuel president of National, and Fredric R. Mann, pres Seaboard. Mr. Mann will shortly join Nationa executive management.

Seaboard's plants, the joint announcement said, about 60,000 tons of containerboard per annum, o approximately 45,000 tons will be filled by Nation tainer's paperboard mills immediately, and the balan Seaboard's present commitments terminate. The S acquisition coincides with the start of production at N new 500-ton-per-day pulp, board and paper mill near V Ga. In addition to this new unit, National has fi

mills, in Florida, Virginia, Ohio, Michigan, and Wisconsin. National Container, including the Seaboard units, now operates 20 corrugated paper box shipping plants, located from coast to coast, as well as two multi-wall paper bag plants and a partition and bottle-carrier plant.

The Madison Branch of the Georgia and Florida Railroad was transferred recently to the new Valdosta-Southern Railroad, wholly owned subsidiary of National Container Corp. The Valdosta-Southern, running approximately 28 miles from Valdosta to Madison, Fla., will connect National Container's recently completed 500-ton-per-day kraft pulp, board and paper mill to four trunk lines—the G & F, Seaboard Air Line, Atlantic Coast Line and Georgia Southern and Florida Line (part of the Southern Railway System). The mill is located at Clyattville, Fla.

Cost of the new line was "in excess of $200,000," according to James Laurie, acting general manager of the G & F, and William T. Webster, a vice-president of the Valdosta-Southern and manager of National Container's mill operations. General offices of the new line are in Clyattville.

The transfer was completed when Alfred W. Jones, receiver for the G & F, accepted payment for the line from Samuel Kipnis, president of Valdosta-Southern and National Container, and in turn handed over the deeds. Negotiations began in December, 1950, when National Container first surveyed the Clyattville site for its huge new mill.

Allied Paper

The Allied Paper Mills announce an expansion program at its King Division mill in Lake Street which will make Kalamazoo the center of the most advanced plant in the world for production of base stock photographic paper.

The new unit will be a 45 by 112-ft. three-story building to house the Photo Paper Division located at the King Division.

Lyle C. Jenness (right), head of the chemical engineering dept. at the University of Maine, is shown receiving the fourth annual Honor Award given by the University of Maine Pulp and Paper Foundation. The presentation is being made by J. L. Ober, president of the Foundation and vice-president of the Scott Paper Co., Chester, Pa. The award was given to Prof. Jenness at a U. of M. Pulp and Paper Alumni Luncheon in New York on February 17

An Allied official said the building is to be completed and production in the new unit to start by "the middle of the Summer." The cost of the entire project was not announced, though highly specialized features of the unit indicate it will be a significant expansion in the growing Kalamazoo industrial scene.

The new building will be located at the north end of the King mill. Two floors will house production facilities for the highly specialized production of base stock photographic paper, and the third floor will house the engineering offices.

This will expand the development of the Photo Paper Division at the King mill under way since 1939 in a joint project with the Lee Paper Co. Vicksburg, which has made the local plant one of the only two prime source suppliers of "baryta" coated photographic base stock in the entire Western Hemisphere. The only other prime producer in this country is the Eastman Kodak Co.

The new building will have unique features setting it apart from the usual industrial plant.

The structure will be so constructed that outside air cannot be admitted until it has been so thoroughly filtered that even cigarette smoke would be removed. Temperature and humidity will as well be rigidly controlled.

The building itself will be completely air tight, much of the materials' handling will be by automatic devices, and personnel will be provided with segregated facilities for entering and leaving the plant.

The air into the plant will be filtered to such a fine degree to remove any traces of impurities that "even radioactive atomic dust" will be removed.

This plays a vital part of the production since only the slightest trace of radioactivity would ruin the base stock photographic paper for sensitizing into photographic film.

As it is, production in present facilities is now continuously monitored with a Geiger counter to guard against radioactivity. Company officials said this is a precautionary measure and radioactivity has not interfered with production at the local plant.

The company executive said without reservations the plant unit to be constructed "will be second to none in the world" for the specialized production of base stock photographic paper.

The building will be constructed of glass block and smooth tile for both the outside and inside walls. The air-tight construction will be carried out to such a minute degree that even a special mortar will be used in laying the tile which will prevent any possibility of dust or of impure air seeping into the structure.

The new unit will contain a coating machine of unique and highly specialized design suitable for the production of a wide variety of photographic specialties.

Production facilities also will include a new supercalender stack for applying the high finish required for glossy prints, and for production of "a-print-a-minute" cameras. A rewinder will be installed especially suited to the high degree of inspection and cleanliness of the products involved.

du Pont

E. I. du Pont de Nemours and Co., Wilmington, Del., is expanding its laboratory for toxicology and industrial medicine by the addition of a two-million dollar building.

G.E.

General Electric Co., Schenectady 5, N. Y., has issued a bulletin (GEA-5786) on the operation of electrified log-carriage drives with amplidyne control, and a bulletin (GEA-5992) on speed variator amplidyne-controlled log-carriage drives.

G.E. plans to build a new plant in Roanoke County, Va., to house its industrial control equipment department, which will be transferred from Schenectady, N. Y.

Edgar Bros. Merger

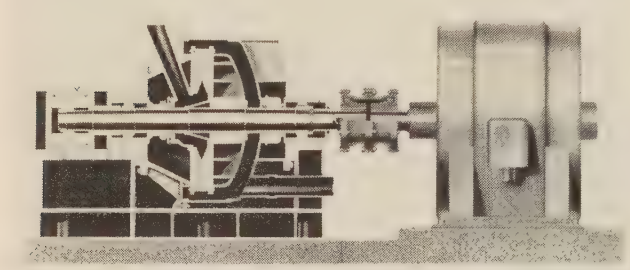
American Minerals & Chemicals Corp. is to be the name of a new company formed by the merger of Attapulgus Minerals & Chemicals Corp. and Edgar Bros. Co. Officers of the new company will be: James Deshler, chairman; Wright W. Gary, president; David E. Lilienthal, chairman of the executive committee and the research policy committee; Alfred G. Blake, executive vice-president; R. H. Hubbell, Jr., vice-president; Charles W. Nielson, treasurer.

Philadelphia Quartz

Philadelphia Quartz Co., Public Ledger Bldg., Philadelphia, Pa., has patented a new adhesive process, known as Stixso 3-Way, for high-speed laminating. The adhesive is prepared at the corrugating plant, and license for the process is allowed without royalty charge.

Bauer

The Bauer Bros. Co., 1715 Sheridan Ave., Springfield, Ohio, is manufacturing a new 44-in. refiner, No. 440, designed especially for stock preparation service. Designed for use with a 450 to 750-hp. motor, the new refiner is intended to be fed and discharged under pressure.



The new Bauer No. 440 refiner

Pennsalt

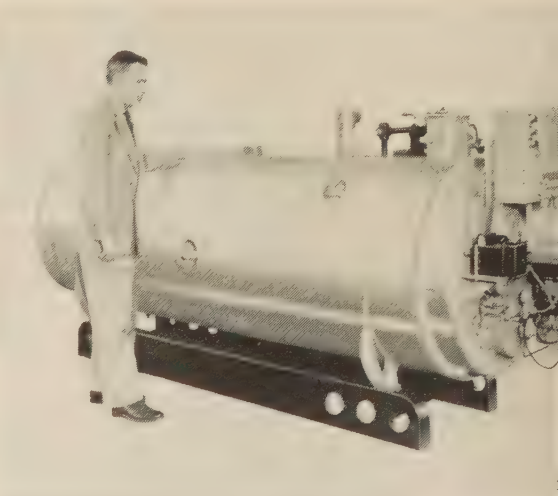
Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa., will establish two new operating divisions, the Industrial Chemicals and Chemical Specialties divisions, each responsible for manufacture and sale of its own products. William P. Drake becomes president of the Industrial Chemicals Division, Albert H. Clem, president of the Chemical Specialties Division, and William F. Mitchell vice-president in charge of purchasing, engineering, and traffic for the consolidated company.

James Deshler, Edgar Bros. Co.

J. D. Homan, Jackson & Co.

Cleaver-Brooks

Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee is manufacturing a new packaged boiler, designated



Cleaver-Brooks packaged boiler

in 15 to 40-hp. sizes. Also manufactured by Cleaver- is a new "4" Hev-E-Oil burner, designed to heat a b containing over 1500 sq. ft. of radiation surface.

Jackson & Church

J. D. Homan, Tampa, Fla., has been appointed facturer's representative in the Gulf States area f Zenith Press and the Roto-pulper of Jackson and Chur Saginaw, Mich.

Permutit

J. Harrahill has been appointed plant manager, and Richardi assistant plant manager of the new Lancaste plant of the Permutit Co., 330 W. 42nd St., New York

Antara

Antara Chemicals, sales division of General Ani Film Corp., 435 Hudson St., New York, N. Y., has pu a booklet describing two new ultraviolet absorbers, 400 and Uvinul 490.

Burtonite

The Burtonite Co., Nutley 10, N. J., has issued a b giving technical data on Burtonite No. 7, a new gum extracted from cultivated guar seeds.

Dorrco

The Dorr Co., Stamford, Conn., has published b describing the Dorrco Hydro-Softener and the Aldrich PeriFilter System.

The company is commemorating the 50th anniver the invention of the Dorr Classifier by establishing an fellowship at Rutgers University, for graduate st metallurgical, chemical, and sanitary engineering.

A-C

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has available three 35-mm. educational sound slidefilms belt drives, prepared for maintenance men, plant eng design engineers, and engineering students.

A new A-C bulletin (20B6956B) gives a new meth calculating horsepower capacity of Texrope drives.

Carborundum

F. Jerome Tone, Jr. has been appointed senio

president, and Frederick T. Keeler has been made director of sales for The Carborundum Co., Niagara Falls, N. Y.

FIBERGLAS

Owens-Corning Fiberglas Corp., Toledo, Ohio, in its annual report for 1953, notes the following new developments and applications: Fiberglas-reinforced plastic automobile bodies and other component parts; a new Stria acoustical tile and a new method of installing Fiberglas tile and ceiling

Installation of Fiberglas acoustical tile ceiling on wood furring strips using the new "full-spline" system just announced by the Owens-Corning Fiberglas Corp. An aluminum spline, previously inserted in the kerfed edge of the 3/4-in. tile, is stapled to the furring strip

board (see cut); coated Fiberglas insect screening; improvements in storage battery plate separators; molded products for automobile dash panel pads; roofing felt; improved pipe covering; paper and tape reinforcing; gypsum board reinforcing; improved cold insulation products and processes.

Dan E. Morgenroth has been appointed manager of Fiberglas general construction materials sales.

INDUSTRIAL NUCLEONICS

Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus, Ohio, is producing a new AccuRay beta gage for measuring the thickness of coatings on base materials or the thickness of sheets passing over a roll.

B & W

The Babcock & Wilcox Co., 161 E. 42nd St., New York, N. Y., has issued a data card (TDC 151) on tubing steel (Croloy 9M) for elevated temperature and pressure applications.

G. A. Profita has been made regional manager of the manufacturing dept. of B & W's Boiler Division.

WESTINGHOUSE

Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh, Pa., is supplying $1,750,000 worth of equipment for the Ketchikan Pulp Co.'s new mill at Ward Cove, Alaska.

A new Westinghouse booklet (B-6133) covers electrical modernization in industrial plants.

C. B. Campbell has been appointed chief engineer for the South Philadelphia Steam Division of Westinghouse.

MIMA

A new water-resistant insulation has been developed by the Magnesia Insulation Manufacturers Association. The new form of 85% magnesia for hot piping and equipment offers protection against insulation damage from water exposure.

RELIANCE

Managers from 12 sales districts of Reliance Electric and Engineering Co., Cleveland, Ohio, at a recent sales meeting, predicted that industrial purchases of electric motors, adjustable-speed drives, and related equipment in 1954 will be at least as extensive as they were in 1953.

Fred E. Harrel, vice-president of Reliance, has been made director of special projects. Hugh D. Luke has been appointed manager of manufacturing of rotating equipment, and Stephen W. Feiss has been promoted to general superintendent of the Ivanhoe Division of the company.

HUYCKFELT

Frank P. Knack, Alan R. Boyd, and W. D. Stroud have been appointed district managers for F. C. Huyck & Sons, Rensselaer, N. Y.

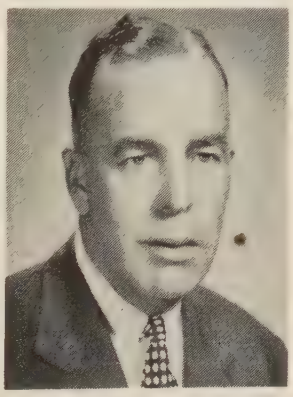
C. Westcott Gallup, Jr., has been appointed to the sales staff of Huyckfelt, after completing the Huyck training program.

F & P

Fischer & Porter Co., Hatboro, Pa., has issued a catalog (No. 91–106) describing an improved automatic system for varying the number of pumps needed to satisfy fluctuating demands in multiple pump installations. Another new catalog (No. 10-F-70) described a self-contained flow regulating device for clean gas-free liquids.

F & P, by acquiring the patents and engineering personnel of the Electrical Development Co. and the Digi-Coder Corp., can now supply data reduction systems for complete plant automation. By such a system, a production schedule can be typed on a punched tape which is fed to a converter to produce an analog output, change the set-points of process controllers, and shift the entire factory from one grade or quality of product to another.

F. P. Knack



A. R. Boyd

W. D. Stroud

C. W. Gallup, Jr.

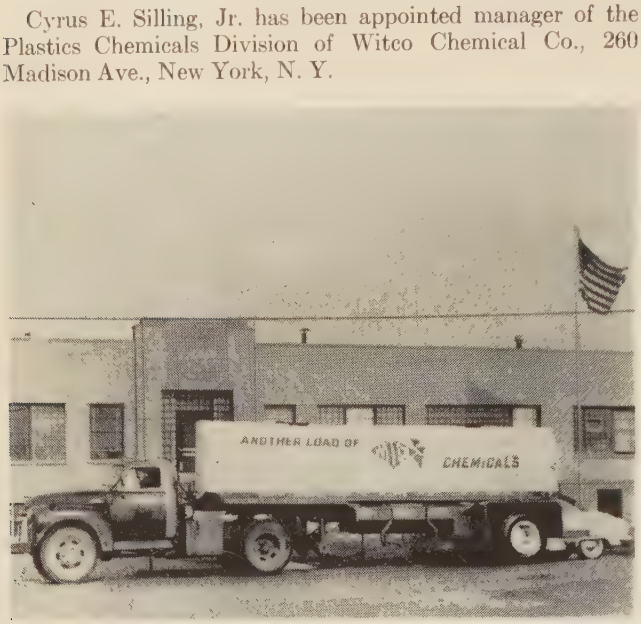
F. C. Huyck & Sons

BELOIT

Beloit Iron Works, Beloit, Wis., has issued a booklet describing a new line of Beloit winders.

WITCO

Cyrus E. Silling, Jr. has been appointed manager of the Plastics Chemicals Division of Witco Chemical Co., 260 Madison Ave., New York, N. Y.



Witco has placed two new tank trucks in its plasticizer delivery service. These trucks are compartmented so that from two to four different plasticizers can be delivered at one time. One truck has two compartments of 1000 gal. each while the second has four baffled compartments totalling 5300 gal.

Witco has placed two new tank trucks in its plasticizer delivery service.

MINNEAPOLIS-HONEYWELL

Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia, Pa., has published a catalog (8203) covering Honeywell control motors and motorized valves.

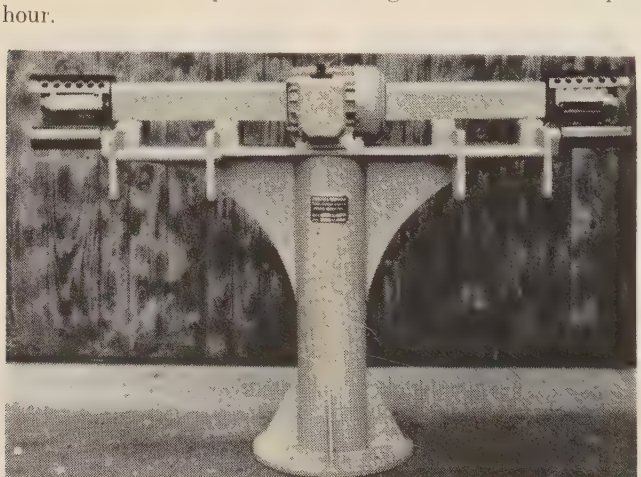
Honeywell's catalog 800 describes series 800 diaphragm motor valves.

DOWELL

Dowell Inc., Box 536, Tulsa, Okla., has issued a bulletin on Dowell Chemical cleaning service for industrial equipment.

SLAB-PEELER

Armbruster & Schausberger, Kapfenberg Hafendorf, Styria, Austria, is producing a peeler for sawmill slabs. In use in Austrian, Italian, and Swiss mills, it is claimed that one woman worker can process an average of over one cord per hour.



SILICATE FIBRE BOX MANUAL

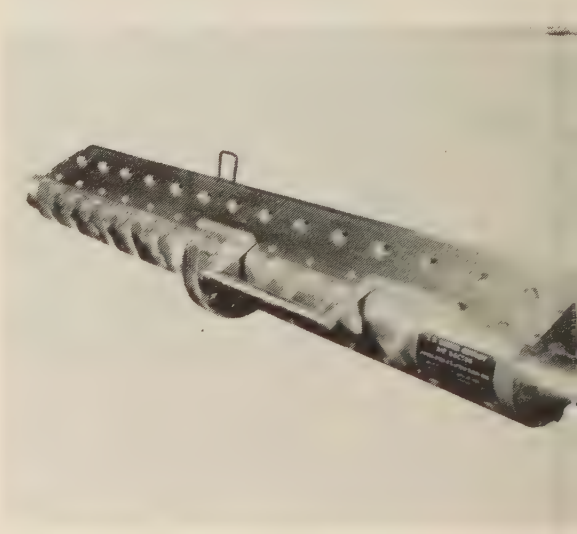
Sodium Silicate Manufacturers Institute, P.O. Bo William Penn Annex, Philadelphia 5, Pa., has publi booklet "Silicate Fibre Box Manual," giving procedu the use of silicates in corrugating.

COMBUSTION ENGINEERING

R. C. Elmer has been appointed head of the Research of Combustion Engineering, Inc., 200 Madison Ave York, N. Y.

BLACK-CLAWSON

A recent agreement provides for the inclusion of the Warren air doctor as part of coating installations supp



Warren air doctor

the Dilts Machine Works Division of the Black-C Co., Fulton, N. Y.

LINK-BELT

Donald E. Thal has been appointed central genera of the Pacific Division of Link-Belt Co., Chicago, Ill.

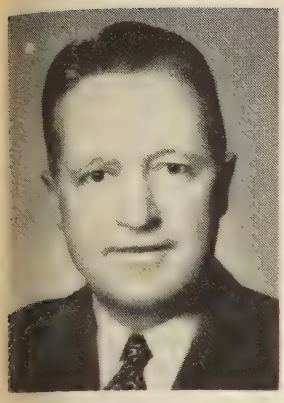
FOXBORO

Foxboro Co., Foxboro, Mass., has issued a bulletin describing two portable temperature indicators, the tiometer Indicator and the Resistance Thermometer.

ROSS

J. O. Ross Engineering Corp., 444 Madison Ave York, N. Y., has launched an expansion program th include a new plant in Los Angeles, Calif., an addition plant in Montreal, Que., and expanded engineering ar facilities in its New York offices.

New Ross Engineering plant in Los Angeles, Cali under construction



T. A. Printon, Nopco Chemical Co.

E. C. Reed, Albany Felt Co.

A Foxboro leaflet (TI 29-B-52a) described the Batch Stabilog Controller, designed to prevent "overshoot" of a variable during the start-up of batch processes.

NOPCO

Thomas A. Printon has been elected chairman and president of Nopco Chemical Co., Harrison, N. J. Richard F. Spain has been appointed mid-west district sales manager for Nopco.

CYANAMID

The Manufacturers Chemicals Dept. of American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y., has published a booklet, "The Chemistry of Melamine."

ALBANY FELT

Everett C. Reed has been appointed assistant vice-president of Albany Felt Co., Albany, N. Y.

INGERSOLL-RAND

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., has issued a bulletin (No. 7126-D) describing a new air-conditioning centrifugal pump, the $^3/_4$ KRVSA Motorpump.

HUMPHREY ELEVATOR

Humphrey Elevator Co., Faribault, Minn., has published a bulletin (HB-54) describing Humphrey Man-Lift Elevators.

Shown here at one of the sessions of their 1954 annual Sales Engineering Conference, Stowe-Woodward's sales engineers review with their research and manufacturing technicians the success of specialized roll coverings made for papermakers in the past year and explore new developments and problems of rubber roll manufacture to speed papermaking. Left to right around their conference table are: T. T. Ericksberg, F. L. Phelps, Jr., C. M. Schermerhorn, Mark LaRue, A. F. Fisk, Roy Tewksbury, H. H. Jensenius, E. S. Greene, D. G. McRitchie, Jr., C. A. Nicholas, Huntington Rubber Mills, Inc., Seattle Wash., Stowe-Woodward's affiliate on the West Coast; J. D. Retallick, F. P. Thornton, Jr., J. D. Dickson, Jr., W. E. Greene, C. Morganstern, W. B. West, C. B. Blanchard, R. P. Arnold, J. H. Glander, L. J. Schillo

OBITUARIES

Thure C. Duvall

Thure Carl Duvall, manager of the Development Department, Wood Conversion Co., Cloquet, Minn., died suddenly at his home in Cloquet in March.

Mr. Duvall was born in St. Paul, Minn., on Dec. 18, 1910, and graduated in Forestry from the University of Minnesota in 1933.

In 1933 he became a junior forester in the U. S. Forest Service, Duluth, Minn. He joined the Wood Conversion Co. Development Department in 1937.

Mr. Duvall was a member of the Technical Association of the Pulp and Paper Industry. At the Annual Meeting of the Association he was appointed to the chairmanship of the TAPPI Structural Fibrous Materials Committee.

Funeral services were conducted in the Presbyterian Church in Cloquet. He was buried in Maple Grove Cemetery. Mr. Duvall is survived by two sons, Thomas and Robert, a brother and a sister. His wife Elsie died a year ago.

Agart Wiberg

Agart Wiberg (Retired), former superintendent of the Gilbert Paper Co., Menasha, Wis., died in March after a three weeks' illness.

Mr. Wiberg was born in Sando, Sweden, on Feb. 5, 1886, and was graduated from the Technical University, Stockholm, Sweden. Following his graduation, he was employed for a year as a chemist for Kramfors, Sulfitfabrik, Kramfors, Sweden.

He came to the United States in 1909 and joined the Crown Willamette Paper Co. organization as a chemist. After five years he became professor of chemistry at the Washington State College.

In 1920 he became chief chemist of the Gilbert Paper Co. in Menasha, Wis., later becoming superintendent. He was a member of the Technical Association of the Pulp and Paper Industry since 1920.

Louis B. Newman

Louis B. Newman, vice-president of Newman & Co., Philadelphia, Pa., died on Feb. 7, 1954.

Mr. Newman was born in Philadelphia, Pa., on April 15, 1907, and was graduated as a mechanical engineer from Drexel Institute, following which he became chemical engineer for the Phil-Fiber Boxboard Co., Philadelphia, Pa.

In 1950 he joined Newman & Co.

Albert Kung

Albert Kung, chief chemist of Cellulosefabrik Attisholz, Lutherbach, Solothurn, Switzerland, died in March.

Mr. Kung was born in Wagenhausen, Switzerland, on May 20, 1883. In 1909 he graduated from the Technical University of Zurich.

From 1909 to 1918 he was professor of chemistry at the Kautonschuh, Solothurn, and in 1918 he became chief chemist of Cellulosefabrik Attisholz.

Reviewers of the technical literature are familiar with several of the important technical papers published in European Journals by Mr. Kung.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Pulp Testing Committee

The meeting of the TAPPI Pulp Testing Committee was called to order at 2:30 p.m. at the Commodore Hotel, New York, N. Y., by Chairman Frank Caskey.

In attendance were:

C. E. Brandon, Howard Paper Mills, Dayton, Ohio
F. A. Delforge, Robert Gair Co., Inc.
J. P. Casey, A. E. Staley Mfg. Co.
R. I. Thieme, Scott Paper Co., Anacortes, Wash.
F. E. Caskey, Crown Zellerbach Corp.
Al Graef, Weyerhaeuser Timber Co.
H. T. Robson, Union Bag & Paper Corp.
J. d'A. Clark, Consulting Engineer, Longview, Wash.

The initial proceeding consisted of a review of the year's work. Chairman Caskey reported three meetings were held this year—two were held in Longview and one in Everett. The subjects discussed were: Vacuum Couching, the Effect of Changing Temperatures on Physical Testing, The Zero Span Tensile Tester, and Methods of Fiber Length Determination. Mr. Caskey stated that aluminum foil, to calibrate the mullen tester, had been a problem in procurement. At the present time this problem has been turned over to the Paper Testing Committee.

The work which has been done on dirt counting methods has resulted in the collection of considerable data. The data have been turned over to the Statistical Committee for analysis.

The question of a standard reference pulp was discussed. Mr. Caskey stated that a notice would be placed in *Tappi* magazine to all concerned, to the effect that this standard reference pulp could be available to the industry, if enough interest is shown. Mr. Brandon suggested that letters be sent to the technical directors of each mill, informing them of the availability of the pulp. Mr. Delforge said that they had tried quite a few such tests in various branches of the Gair Co. and had very little success in correlating testing between the different branches of the same pulp. Mr. Brandon suggested that the standard pulp be sent out free to all mills who would like it, to have them test it and report the results to the Pulp Testing Committee.

Parts of the standard procedure T 200 were discussed. It was brought out that this procedure stated that, to disintegrate a pulp sample, the defibrator should be run to 10 min. or until specks of pulp which could be found, averaged less than $^1/_{16}$ in. in diameter. Tests have shown that some unbleached sulphite at 95% o.d. is a very hard pulp to disintegrate and is still full of specks after 4 hr. It was suggested that conditions should be more closely specified as to the size of the container in which the disintegration occurs, and so on.

It was suggested that under method T 205 the phrase "Simulate conditions as closely as possible to papermaking" should be eliminated.

A discussion was held as to whether the permanganate number and bleachability determination should be a function of this committee, or of the Chemical Methods Committee. At the present time it is included under the committee on chemical methods.

A discussion was held upon the measurement of stock consistency. The discussion boiled down to the fact that the main question was the method of sampling. Some additional work will be done on this problem. It was decided by the committee membership that unless some good reason were found to the contrary, the terms "consistency" and "c ence" would be considered synonymous terms.

A discussion was next held upon the suitability of t of the present British sheet mold. It was brought ou the size of the sheet is too small to get all the tests requ desired. In some instances it was very difficult to g mullen sheet to come under the mullen tester clamp. matter of fact, some of the members insisted that it w possible to get all the tests recommended from one with the sheet mold at its present size. It was sug that a 7-in. sheet mold be used. One of the members c that they were now working with a larger sheet mold a mill. He will report the results of their tests later.

A question was raised as to whether moisture tests w on all the hand sheets made. It was proposed that sheets be tested in the humidity of 50% and all the t reported on that basis.

Apparently some confusion exists over the wordi scribing the tear test. It was thought that an expla should be made that, when 16 sheets are torn, the r obtained represents the force in grams to tear a single sh

A point was made and agreed to that letter ball sent out to all the membership to decide on any issues required the sanction of the Pulp Testing Committee.

The meeting was adjourned at 4:30 p.m.

AL GRAEF, *Acting Secr*

Water Committee

The Water Committee meeting was held in the Gran room of the Hotel Commodore at 2:00 p.m., Monda 15, 1954, with the following present: A. S. Er chairman, C. L. Anderson, H. E. Berg, J. S. Kneale, Martin, E. N. Poor, W. A. Tanzola, A. Thurn, R. J. K W. C. Taylor, S. Bergen, J. N. Stephenson, and R. G.

The possibility of rotating the chairmanship of th mittee was discussed. It was agreed that the tenure c should be two years with the program chairman next This procedure will give the program chairman a cha familiarize himself with committee work, and at th time train a successor for the job of program chairman present chairman will carry on for 1954–55 with A. the program chairman, taking over for 1955–56.

The Water Use Questionnaire, a survey carried ou eratively by the water Committee and the Conse Foundation, was discussed with Stephen Bergen Conservation Foundation. Interpretation of the res the questionnaire remains to be done and this will be taken by the chairman.

J. N. Stephenson brought the committee up to d the New Volume IV of "Pulp and Paper Manufa The chapter on water is complete, except for data or usage for various operations. Mr. Stephenson will this information from the summary of the Water Us tionnaire.

In conjunction with Project No. 208—Preparation o tine Control Methods—C. L. Anderson will review the of the 1952 survey on analytical methods for white and effluents. It is hoped that this study will turn procedures which can be recommended for routine methods.

Work on the second monograph on water will be a

pressed this year under the guidance of E. N. Poor. All the members of the Water Committee will assist Mr. Poor in this undertaking by reviewing the first monograph and sending Mr. Poor their suggestions. This will include detailed comments on what sections should be rewritten and how, as well as possible authors to undertake the various write-ups. Mr. Poor will handle the monograph in a manner similar to the way Mr. Stephenson is rewriting the textbooks.

Committee Project No. 466—Suspended Solids Determination by Buchner vs. Gooch Methods—will be reactivated this year. The work is being carried out by The Institute of Paper Chemistry under the direction of B. L. Browning.

A. S. Erspamer, *Chairman*

Paper Testing Committee

The Paper Testing Committee met at the Hotel Commodore, New York, N. Y., Feb. 15, 1954, for their annual meeting. Those members in attendance were: D. H. Newcomb, chairman, D. M. Black, W. P. Dohne, R. B. Hobbs, M. S. Kantrowitz, S. C. Fairbanks, P. F. Wehmer, and B. L. Wehmhoff. In addition there were numerous guests who actively and generously participated in the activities of the meeting.

The chairman gave a brief report of the activities of the committee during 1953. He reported that in addition to the annual February meeting the committee had held a very successful Fall meeting at the Battelle Memorial Institute, Columbus, Ohio. During the year two committee sponsored methods were accepted by the Standards Committee. These were; Blood Resistance of Butcher's Wrapping Paper as a Suggested Method and Pin Holes in Glassine and Greaseproof Papers as a tentative standard. There were also four other test methods which were acted upon by the committee as either being reapproved or being advanced.

The chairman announced the status of the various subcommittees as follows:

I. Thickness and Bulk Studies, B. L. Wehmhoff, Chairman.
   (a) Thickness and Bulk of Book Papers, B. L. Wehmhoff.
   (b) Thickness of Thin Papers, P. F. Wehmer.
   (c) Bulk of Tissue and Crepe Papers, J. T. Ward.
II. Water Resistance of Paper (Dry Indicator Method); R. B. Hobbs.
III. Dirt in Paper, R. H. Wiles.
IV. Turpentine Test for Grease Resistance, S. C. Fairbanks and W. P. Dohne.
V. Pick Test, M. S. Kantrowitx and B. L. Wehmhoff.
VI. Erasure, P. W. Codwise.

The test methods discussed during the February 15 meeting were as follows:

T 411 m-44—Thickness and Density of Paper, B. L. Wehmhoff, Subcommittee Chairman

As discussed in the Fall meeting and outlined previously, past discussions have indicated the desirability of regrouping the various phases of the testing for the thickness and density of papers. B. L. Wehmhoff as over-all chairman of the subcommittee studying thickness and bulk reported that as far as book papers are concerned enough information and data have been accumulated to write a test method. It has been well established that when thickness is measured a micrometer reading of a single sheet is taken. The bulking test for book papers is less standardized although the various test methods available have much in common, the greatest difference being in the amount of weight used. It was brought out that the Perkins bulking tester is no longer available but that they are awaiting a standard TAPPI test method before proceeding to manufacture such an instrument. Mr. Wehmhoff is to write up a suggested test method for measuring the thickness and bulk of book papers.

P. F. Wehmer, subchairman for studying the thickness of thin papers, reported that his studies indicated a need to first define thin papers and that methods available for the measuring of thin papers depended largely upon the instrument used, such as the mechanical spring micrometer, dead weight micrometer using 4 p.s.i. and the standard TAPPI instrument using 8 p.s.i. Mr. Wehmer suggests very strongly that TAPPI follow closely the ASTM method D 374–42 and will write a suggested method for the committee using the method as a basis.

J. T. Ward was unfortunately unable to attend the meeting but reported by letter that work was progressing in obtaining data and information so that a suggested method can soon be written for measuring the thickness and bulk of tissue papers.

T 433 m-44—Water Resistance of Paper (Dry Indicator Method), R. B. Hobbs, Subcommittee Chairman

Since the Fall meeting Mr. Hobbs reported on the work done on this subject by Carson and Worthington. Briefly this work pointed to three sources of variation for the test: (1) the inclusion starch in the dry indicator, there still seems te be differences of opinion on this; (2) the technique of preparing the mixture; and (3) the characteristics of the methyl violet dye. As a result of the discussion that followed it was agreed that Mr. Hobbs and Mr. Kantrowitz would continue this work and in particular would compare the existing TAPPI and ASTM methods. As a result of this comparison they are to write a proposed revision of T 433 m-44.

T 437 m-43—Dirt in Paper, R. H. Wiles, Subcommittee Chairman

Neither Mr. Wiles, subcommittee chairman, nor Mr. Ward was present to give a progress report, however by letter this subcommittee has reported the writing of a revision of T 437 m-43 incorporating the ideas and findings of this subcommittee. This revised method will be submitted to the full committee for vote as soon as copies can be obtained. In connection with submitting revisions or suggested methods to the full committee for vote Mr. Kantrowitz suggested that the committee adopt the practice of requiring that each negative vote cast be accompanied by comments as to why the negative vote was cast and any suggested changes deemed necessary. This suggestion was put in the form of a motion and was duly adopted by a show of hands of the committee members present.

T 454 m-44—Turpentine Test for Grease Resistance of Paper, S. C. Fairbanks, Subcommittee Chairman

Mr. Fairbanks reported that a revision to T 454 m-44 is to be made incorporating the wording established in T 485 m-53, Pin Holes of Glassine and Greaseproof Papers, as to the backing papers and turpentine used. Mr. Fairbanks further reported that work to date on establishing a standard method for measuring the grease resistance on the crease was not sufficient for writing such a method. He did report that the work had indicated that more accurate results are obtained when a dead weight is used rather than a rolling weight to make the crease. However, the exact weight to be used has yet to be determined. Tests indicate that 5 lb. weight is too great. Work is to be continued along these lines.

T 459 m-48—Wax Test for Surface Strength of Paper, B. L. Wehmhoff, Subcommittee Chairman

Mr. Wehmhoff reported that work is continuing by the Paper Printability Subcommittee of the Research Committee of the Lithographical Technical Foundation, but at present there is not enough information available to make any revisions to T 459 m-48.

The chairman announced that the Paper Testing Committee would attend the Fall Testing Conference at which time progress reports on all active projects will be expected.

Two new members were admitted to the Paper Testing Committee. They were L. M. Tyler, Howard Paper Mills, and S. E. Church, State University of New York.

D. H. Newcomb, *Chairman*

REPORTS AND DISCUSSIONS

Presented at the National and Regional Conferences

Digester Corrosion

During the Eighth Engineering Conference of the Technical Association of the Pulp and Paper Industry which was held in Montreal, Que., Oct. 26–29, 1953, the Digester Corrosion Subcommittee of the Chemical Engineering Committee sponsored a session on digester corrosion and related topics. The following is a record of the discussion, and reference is suggested to the formal papers "Comparative Analyses of Digester Corrosion Measurements," by Nicholas Shoumatoff and H. O. Teeple, *Tappi* 37, No. 4: 166–171 (April, 1954) and "Comparative Analysis of Digester Corrosion Measurements," by A. Ungar and T. E. Caywood, *Tappi* 37, No. 5: 177–190 (May, 1954).

H. F. Peters (Lukens Steel Co.): Thank you, Nick. I believe Herb and Nick should be commended for the time and the effort they have put into the analysis of these corrosion data. However, I find it difficult to agree that carbon steels, which, in certain cases, appear to be more corrosion resistant than Inconel or 18–8 stainless, are by any means ordinary steels. Specifically, mill F, as indicated in Mr. Teeple's paper, which contributed information on digester corrosion on 31% of the digesters tabulated, showed an average corrosion rate as 22 mils per yr. for all ordinary steels, 29 mils per yr. for Inconel, and 31 mils per yr. for 18–8 stainless. This, in our conception of carbon steels, is not an ordinary steel. Also, since in mill H this ordinary steel is presented as being more corrosion resistant than the old rim steels. The statement was also made that since variations among mills are not generally significantly greater than within mills, comparison of digesters by types need not be restricted to a within mill basis, thus making available a broader basis of pertinent evidence. This is rather confusing for, discarding the one Inconel digester in mill C which originally was given a minus corrosion rate, it places the alloys in the following preferential order for sulphate service: type 410 with 15 mils per yr., type 347 with 26 mils per yr., Inconel with 29 mils per yr., and 316 with 31 mils per yr. This is, I believe, quite contrary to the present trend of thought and experience which is that Inconel and type 316 stainless are generally considered the best choice of the considered materials for sulphate service. This mill to mill comparison also presents the so-called new rim steels as being less corrosion resistant than the high tensile silicon killed steels and the old rim steels less corrosion resistant than the new ordinary steels. All of this seems to lead to one of two alternatives: either the rate of digester corrosion cannot be specifically compared between mills and so the problem in each mill is a special case, which weakens broad generalizations on the material for the service, or that the data as computed are statistically insignificant.

N. Shoumatoff (West Virginia Pulp & Paper Co.): Thank you very much, Hank. There are several questions there. I will answer first, if I may, and then perhaps Herb would like to add something. I would like to mention that, due to lack of time Mr. Teeple had to cut his paper quite drastically as you have probably noticed if you have read the copies which we distributed. I would like to call your attention to the section where we outlined a series of ten steps for further study, one of which was rechecking the Armour results where they are contrary to expectations and otherwise anomalous or especially noteworthy. We certainly will look into these questions that were mentioned but, as of now, we merely presented the facts as they were developed from the I would like to mention, in connection with the alloy conclusion was that, in every one of the case comparison ordinary steel, the alloy was better within mills but th rates were higher than we expected. The paper has a with the data on each of the individual 89 digesters used study, so, if you wish to go through the actual origina and make your own comparisons, you can do so. N hope we will be able to verify this point, although I ar there is a lot of information in these data that we wo able to discuss in complete detail today in the short ti have as we have other papers to discuss. Inconel, yo note from the figure, has an average rate of 29 based or vessels, which is certainly higher than we expected. will look at the original data you will notice one vess quite a bit higher than the other two. The new ordinar 12 vessels has a rate of 41. In mill C the Inconel vesse rate of minus + 1 which means in effect, zero. The ordinary vessels have a rate of 62. Adding the two together, we have four vessels of Inconel with an aver 17; 20 ordinary in the same mills with an average of 50.

Mr. Peters: What is the figure you have for the old nary steel in mill F? And also, my copy here shows a corrosion rate for Inconel in mill C.

Mr. Shoumatoff: It's correct. Plus 1 means a ne corrosion rate or apparent gain of 1 mil per yr., which easily happen from these data. The old ordinary in mil an average rate of 22, which is 7 mils lower than the ord

J. R. Leintz (Union Bag & Paper Corp.): Nick, I wo I could add a little more to the confusion. Mill F ha to be my mill—I have no objection to identifying tha We have five Inconel-clad digesters, but the data wh had available at the time only covered three. Of those one had some rather peculiar characteristics based information we had available but I think that, curren are satisfied that at least four of the five Inconel clad di are showing substantially lower corrosion rates than the of 29 mils per yr. shown on the chart. As you point further studies will have to be made, and we are rech our information on the digesters involved. We still r recheck the calculations to be sure that there is not a somewhere along the line, so, to add to the confusion, say that the rates we show compared to the rates of ste not disturbed us in the least up to this point.

H. O. Teeple (International Nickel Co.): As far Inconel picture is concerned, I have no doubt but what true picture will come out. It is quite true that the have not been in service very long and that we app have had some difficulty in mill F. There were three two of which had corrosion rates of about 10 mils per the other had a corrosion rate of 40 mils per year. The ing comment pertains to the one vessel showing the hi of corrosion, as well as Hank Peters' other commen respect to an apparent evaluation of the various allo which might be used for kraft pulping. This is one peculiar things that seemed to come out in these data. ever, we did not make any attempt to modify the resu came out of the Armour Institute but it certainly is a s situation that the numbers belie the performance tha dicated by actual visual inspection of the various vess was very obvious, for example, that, while type 410 s seems to show the lowest rate of any of the alloys, ne

less, in, I believe, something of the order of 6 or 8 months, perhaps—no, wait a minute, I am not sure about the time—but of the order of time of a year, 3/4 of the thickness of the type 410 had gone and in the course of a year and a half or so carbon steel was showing through the cladding. Well, that is a lot different than a corrosion rate of 15 mils per year. The stainless picture is, I believe, not quite clear compared with what you see when you actually look at the vessel. The 316 generally performs better than these data indicate. I am not trying to say that these numbers are wrong. I am just merely pointing out that limited experience to date does present, to some extent at least, a picture which is considerably different from what the numbers actually show. To further comment on that point, all one has to do is to remind you that we found the average corrosion rate for all the carbon steel vessels in the United States to be 31 mils per yr. and that the highest was 122 mils per yr. in a certain spot—it happens to be the upper shell. Since 122 mils per yr. is a lot different than the average of 31, it is obvious that these results probably would have been much more statistically reliable had we had an unlimited population from which to draw the data.

Mr. Shoumatoff: Thank you, Mr. Teeple. There is a lot more I would like to say on that subject but I am afraid that we have to ration our time. We have time for a few more questions on the first paper presented this morning by Mr. Teeple.

Albert E. Logan (Buckeye Cellulose Corp.): I would like to pose the question as to whether or not any indication of local failure in the form of cracking of the cladding was reported on the Inconel or stainless linings.

Mr. Teeple: You mean that was reported in the data that were submitted to Armour? No, at least I don't believe so; I am sure there were not.

John Frankevicz (Champion International Co.): Has any correlation been made with the species of wood or woods cooked on the corrosion rates of these various digesters within a mill or from mill to mill?

Mr. Shoumatoff: That is one of the things we hope to do in our second report. We believe we do have some data on that.

David W. Hengerer (R. B. MacMullin Associates): I would like to ask the question as to whether steels which were boiler plate-type steels modified with aluminum and titanium have ever been used for kraft digesters? The reason I ask the question is that such steels have been found to be excellent against 50% hot caustic in that they neither embrittle nor corrode at anything like the rate which ordinary boiler plate does.

Mr. Peters: Yes, there are in the data reported a number of digesters used that were aluminum deoxidized. I believe the data on mill C give the corrosion rates on those digesters. The exact number at this time is rather indeterminate. I definitely know of three of them being used.

Mr. Hengerer: The titanium modifies as well, which affects the control of corrosion; the aluminum only takes care of embrittlement, not corrosion.

Mr. Peters: It is difficult for us to answer because we use titanium as a scavenger for hydrogen when the steel is poured on days where weather is wet, such as a rainy, foggy day, so some of those digesters may have slight amount of titanium in them. The specification does not, however, call for titanium.

M. J. Osborne (Bowaters Southern Paper Corp): I am a little bit confused; maybe Herb can straighten me out a little bit. I haven't worked very closely with this project for some time but, in the weighting of this rate of corrosion, this rate of penetration as developed by the Armour Institute, the fact that a digester is condemned or taken from service depends upon a reasonably small area, and it would seem to me that that would have a great deal more significance than the overall rate of penetration, or the average rate of penetration for the entire vessel. Do you find any correlation between the high rate of corrosion over the entire vessel and possibly a streak, as it were? I would like to know because in inspecting a lot of them around the country, I did notice that it would be very thin in one place and right adjacent would be a very thick spot, or maybe the rest of the vessel would be thick and, therefore, the average thickness wouldn't mean very much. I'd like to hear what weighting you are doing on that data, Herb.

Mr. Teeple: Well, Johnny, you have a very good point and that was touched upon by Al Canavan in the presentation of his paper when he was talking about calculation of allowable pressures and that, of course, is dependent upon the thickness at various points within the digester. These average rates generally cannot be used for determining the allowable pressures if the interior surface of the vessel has a gross uneven surface, for example, corroded grooves. That is a special case and requires specific investigation and interpretation. However, where even corrosion is occurring and, since we have found that there is little columnar variation in the vessels, then, we believe that the average of any one row is the best estimate of the wall thickness of the digester at a given row height, so that that thickness can be used in the calculation of the allowable pressure at that point of the vessel.

Mr. Shoumatoff: I would like to make one very brief comment on that. The official report of the Armour Foundation has not been received yet but we do know that it will show a detailed profile for each of these vessels, usually about 28 different elevations in each one, and I believe that those localized areas will show up quite clearly. A more exact method would be to draw contours over the entire grid. As far as correlation is concerned, there is bound to be correlation because the high localized rates were included in the average with no weighting whatsoever, simply an arithmetic mean of all the points in the vessel.

Arthur Drew (Southland Paper Mills, Inc.): I was very interested to hear your remark on the contours because that is the way that I watch our digesters. Every time we take a set of readings I have the contours plotted and it is amazing the way that they follow through. Our digesters have all been replaced, and we have installed four new ones. I was very interested in the drawing illustrating the various ways in which various types of corrosion were found. Now, we found, more or less, all of those types of corrosion in our digesters, but the serious one is the one from the liquor inlet, although ours is not located that high in the digester and we don't have the liquor nozzle. We use a swing pipe to fill and I have been trying to reconcile our corrosion along with the statement that that is caused by the fill pipe, but I haven't quite been able to do it to my satisfaction. In every one of our digesters the thin places have the same orientation, I forget whether it's Northeast or the Northwest, but you draw the contours and you can follow it right through all the time, and the new digesters are showing exactly the same pattern as the old ones.

Mr. Shoumatoff: I believe that many mill operators here could confirm those findings. We will now have to go to the second paper, or the second group of papers, presented by the Canadian group. Are there any questions on any of the three papers which were presented by the representatives of the Pulp and Paper Research Institute of Canada?

C. B. Christiansen (Pulp & Paper Research Institute of Canada): I should like to ask Mr. Drew if he could tell us the shape of the chip pile in the digester during the filling process. Is it a peak in the center or is it high on one side, do the chips come in at such an angle that you have a high pile on one side of the digester in the same direction in each of the four digesters?

MR. DREW: I have not personally been down in the digester when they were taking the readings. We take our readings by running some chips in and taking the set of readings and adding more chips and taking more readings. My recollection is that they were pretty well centered. Johnny Osborne has been down in our digesters so he should be able to tell you all about that. He wanted to know the shape of the pile in the digester.

MR. OSBORNE: Well, the chip pile was reasonably centered. The reason I know is because I had to shovel them around to find a flat place to stand on. Does that answer the question, Claude?

MR. CHRISTIANSEN: Yes, it does, I should like to describe one interesting case that we had. We had one mill where the digesters were arranged in a square; that is, four digesters were in a square and as the chip filling chute was in the center of the square, we had a different direction of chip filling each of the four digesters. We found the pattern followed right around with a 90° change in each digester, right around with this chip filling operation. In these digesters we had overhead swing pipes, liquor pipes, and the liquor was introduced on the far side of the neck, on the high side of the pile, so that it ran down the chip pile toward the center of the square. The inside direction of each digester toward the center of the square was the most corroded area. This was quite an extreme case in that these digesters are all clean of scale except for some areas in the cone and they all looked very much alike. You couldn't tell by the eye if there were any variations in thickness; you would guess there weren't. I understand the insurance people were fooled for some time by this picture but, when readings and drillings were finally taken, they found that the inside side was going at twice the rate of the side opposite, so, we can say that the filling was probably accounting for about half of the corrosion that was occurring on the side against which all the liquor was being directed.

EDWARD W. HOPPER (Crucible Steel Co.): I can confirm the remarks that Mr. Christiansen just made regarding the effect of the contour of the chips. We followed the chip packing from the bottom up to the top in a complete row of digesters; there was a line of demarcation which coincided exactly with the angle of chip repose. Severe grooving coincided with the angle of chip repose, and that was found in the entire line of digesters from one end to the other. So, there was no question at all. We also think some of the corrosion, however, was also caused by packing and channeling, but it coincided exactly with the angle.

MR. SHOUMATOFF: I would like to ask a brief question myself. I will certainly look forward with great interest to a more detailed study of the very interesting data which were presented this morning by the Pulp and Paper Research Program and, in particular, the numbers which were presented by Mr. Lathrop. Incidentally, I am sure you will be interested to know that Mr. Lathrop is a professional Operations Research worker and is the Secretary of the Operations Research Society of America. I believe it is extremely interesting that this new method of thinking and analyzing problems has been brought to bear on this particular problem of the pulp and paper industry. In fact, the Armour Foundation work was also conducted under the Operations Research Department, and I believe that these are the first two instances in which that approach has been used on an industry-wide problem; perhaps Mr. Lathrop will correct me. But the question I want to ask is this. Mr. Lathrop made the statement that the straight line correlation with the liquor concentrations accounted for 80% of the corrosion rate variation. However, as I recall, there were several instances where there was as much as a factor of 3 to 1 deviation of the corrosion rate from the line to the individual points.

MR. LATHROP (Arthur D. Little): If we draw a regression line based upon a chemical hypothesis and it explains 80% of the variation, I think we can explain this by saying that, if these differences among these mill averages were completely
lated to the chemistry involved, there would be a c
variation around the average mill rate but, when we nor
it instead to the average of all the mills, we compare it
regression line which says what we might expect it to be
chemical hypothesis is true. We get rid of a good p
this variation; the variation around the chemical hypo
is only about 20% of what it would be around the mi
whole. Now, Nick, what was your other. . . . you had a
detailed question on that?

MR. SHOUMATOFF: I believe that answered the que
I would like to comment that the Canadian group has
kindly agreed to include some of the TAPPI data in the
correlation. Data from four mills were submitted to
for that purpose with the specific authorization of t
dividual mills. In the future, we plan to send out addi
questionnaires and our intention is that we will, at that
ask permission from all mills to extend these data
Canadians to expedite their work in this connection, wh
certainly of mutual benefit to both of us. Are ther
other questions?

JAMES G. SYLVESTER (Mutual Boiler & Machine Insu
Co.): I would like to ask the Canadian group a question
that comet tail effect on internal nozzles in the digest
was wondering if in any of their digesters that they exa
that they ever came across the exact opposite effect whe
digester would be corroding generally but the comet tail
represent the original material?

MR. CHRISTIANSEN: "Comet tail" is a new term
thought we had picked up most of them but that is a ne
We have found some of the cases that you mention
though they are the isolated cases and, if my recollec
correct, they were associated with a horizontal inlet pip
the top of the digester. We had a short comet tail here
had some kind of scale formation which was resisting
sion, as least to a greater extent than the adjacent
Another case which we have mentioned in previous rep
where a baffle plate has been used in the head of the di
just back of the neck, as a liquor distributor with the
circulating pipe coming in and shooting directly again
baffle plate and then spraying across, the baffle plate be
out a little distance from the digester shell. We fou
type of deflector plate to be coated with a protecting sca
not having suffered any corrosion after some 9 years of s
although the digesters were going on at least an average

MR. TEEPLE: I would like to ask a question. Rem
that one slide which I believe had the designation "D1-
was in the lower left hand corner—and you mentione
you had observed a peculiar surface effect? I wonde
so happens that you have analyzed that particular sa
I am just curious as to what the composition in that s
was near the surface or wherever you made your dete
tion.

MR. GERSHWIN: We did analyze that and I believe w
it in this chart. The thing that we were looking fo
was the various types of corrosion, such as corrosion fa
stress corrosion, and that sort of thing with which you
doubt familiar, Herb. I don't believe the sample
showed any significant difference in chemistry throughou
we happened to do quite a bit of research work on the e
copper and tin on steels, wherein we found that the
build-up of copper and tin at the surface of plate steel
as are used in digesters, this build-up being due to th
that the iron oxidizes on every heating cycle and the
and tin do not. They actually tend to become more
alent at the surface, the percentage of copper and tin
up as much as about ten times that which you find
center of that steel. Consequently, we went after that
as well in our investigation of that sample. We carri
what we call a spectrographic survey. We got spectrog
analysis—this is a rather unique type of thing whi

laboratory has had quite a bit to do with in developing the technique—for such a survey. We actually made spectrographic analyses of the peaks and valleys, or you might say the cracks, the bottom of the cracks, and the top, and so on, right across that sample and we found no difference whatsoever, so we have come to the conclusions: (1) that that particular sample was subjected to corrosion fatigue or (2) that that particular sample had a very fine scale which, for some reason or other, cracked in the same way as you saw the cracks on that slide, and that liquor concentrated within those cracks and caused corrosion. We have taken photomicrographs, the corrosion falls right in causing a rooting effect. Sulphur is another thing that causes rooting, incidentally, but we checked for that, too. Corrosion fatigue, or cracking of scale. That is the answer.

Mr. Teeple: I was quite curious about that because I happened to be inspecting a carbon steel vessel wherein I believe I saw about the same thing and, in this particular case, it was in the head. It seemed to be developing on the undersurface of the head and also extending down in the flange of the head. The liquor inlet pipes were in the flange on the head and this attack was greatly concentrated immediately beneath the white liquor inlet. There were no deflectors or lips on either of these two inlet lines but I was just curious as to whether there might be a hot shortness that would develop in the steel due to, as you have mentioned, a build-up of copper and/or tin on the surface. It sounds like you have done a marvellous job on analyzing these samples.

Mr. Gershwin: That is why we went after the copper and tin, Herb, and also sulphur because those three animals, as we like to call them in the steel industry, do cause trouble of that nature—hot shortness.

Mr. Osborne: I was particularly interested in this nonmetallic inclusion business, that is, the so-called wrought iron theory they are working on here in Canada. I wonder what we are doing in TAPPI about that. I know there are several digesters, quite a few that apparently show no extreme corrosion at all. They have been in a long, long time and they still are practically as thick as they were when they were installed. I know of one digester I tested in a mill where there was one plate in a cone on which I could get no readings with the Audiogage. I made over 200 tries and while the rest of the digester tested reasonably well, there was evidently a lamination there that was so thick that the sound wouldn't go through it and, therefore, it gave false readings. I wonder could anybody answer.

Mr. Shoumatoff: Some extremely interesting data on that were included in a paper by Huseby and Scheil, which was presented some time ago, and I believe that some additional data of that type will be included in Mr. Hopper's paper in February.

Mr. Osborne: I meant, Nick, actually taking samples of digesters that are not wearing out so we can duplicate them, if possible.

Mr. Shoumatoff: There was a question of correlating the analytic data with the corrosion rates. At the moment, TAPPI itself has no active program on that but we are grateful for the work being done by private organizations.

Mr. Teeple: Excuse me, just a second. Nick, I think Johnny wanted to know if we were taking samples. The answer to that is—no. We would like to but it brings up several good questions for which we don't have ready answers, namely, how are we going to do it, who is going to make the arrangements, and who is going to pay for running the analyses. It would be extremely interesting I grant you, but at the moment we do not have any firm plans along those lines.

Mr. Shoumatoff: Well, we have had quite an extensive program this year—that I believe you will agree. I would also like to refer you to Mr. Hopper's paper presented by our committee last February which had analyses of quite a few samples.

Mr. Gershwin: I don't think in my short talk this morning—perhaps I didn't make it quite clear but our data do contain that sort of information. Within the same digester, for example, we have taken out samples from a heavily widespread corrosion area as well as samples from a very lightly corroded area and those are being analyzed exactly the same as were the heavily corroded samples with just that idea in mind.

Mr. Hopper: We have about 60 or more samples going through at the present time on which we are getting complete chemical and spectroscopic analyses and on which we are running edge tests. In some cases we are taking an inclusion count. We have found very appreciable differences in tin content, for instance, in the core and in the rim. There is a marked difference in the inclusion counts and the type of inclusions, whether they are silicates, or sulphides, or oxides. Some of that data will be included but, the thing that is interesting in some of these cases is that the core which is so impure and the rim that is relatively pure and dense as compared with the core, do not show the differences of the rates of corrosion that you would expect, at least from a laboratory viewpoint.

Mr. Shoumatoff: Thank you, Mr. Hopper. Mr. Huseby is here, I believe, and I wonder if he has any comments on that point. No? Thank you, Mr. Huseby. If there are no further questions on any of the Canadian work, we will now turn to the extremely valuable presentation on safety evaluation and protection of digesters by Mr. Parker and Mr. Canavan. Are there any questions on that paper? (See "Safety Evaluation and Protection of Digesters," by H. M. Canavan and W. B. Parker, *Tappi* 37, No. 3: 115–120 (March, 1954).)

Robert C. Stamm (West Virginia Pulp & Paper Co.): Mr. Canavan mentioned the possibility of putting safety valves right on the digester itself. I would assume, of course, you would put those in the vapor zone. However, there is a chance that you could overfill the digester and possibly get a pulp plug-up in the valve, so I am wondering about the potential hazard there and what he would say about that.

Mr. Canavan: Well, in the majority of cases, they are not putting them on the digesters directly, due to the corrosive vapors which attack the safety valves, but I do think that, in some plants where they want to do it, they could put them on in the vapor space. I would say that that is more or less of an operating problem; that, if you did overcharge the digester, there would certainly be some indication that the operator would have during the charge, while he was charging. Of course, I agree with you that, if he does overfill it and gets deposits up into the nozzle opening, there is a good possibility that the safety valve would be inoperative in the case of an emergency.

Mr. Drew: I would like to say that I would not recommend putting the safety valves on the vapor space because I have had some experience with putting them on the steam line behind the throttle valve to the digesters. We put the safety valves right behind the control valves and every time the digester was blown, you had to clean the safety valve before you ever could get it to seat properly and, for that reason, I wouldn't recommend putting them anywhere near the digester.

Mr. Shoumatoff: Thank you, Mr. Drew. Are there any other questions specifically on this paper? I would like to express my personal appreciation to all of you for your contributions and encouragement of our program, and particularly to our Canadian friends for presenting their results alongside of ours which, in many cases, were quite provocative and which I am sure will lead to constructive results.

Analysis of Rosin

Proposed Revision of TAPPI Official Standard T 621 m-42

(THIS STANDARD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING COMMIT

Rosin is a specific kind of natural resin obtained as a vitreous water-insoluble material from pine oleoresin by removal of the volatile oils, or from tall oil by the removal of its fatty-acid components. It consists primarily of tricyclic monocarboxylic acids having the general empirical formula $C_{20}H_{30}O_2$, with small quantities of compounds saponifiable with boiling alcoholic solution of potassium or sodium hydroxide, and some unsaponifiable matter. The three general classifications of rosin in commerce are: (1) gum rosin, obtained from the oleoresin collected from living trees; (2) wood rosin, obtained from the oleoresin contained in dead wood, such as stumps and knots; and (3) tall-oil rosin, obtained from tall oil.

SAMPLING

Rosin is delivered in commercial bags, wooden barrels, metal drums, and tank cars. For the sampling of bags, barrels, and drums, strip off the container, leaving a solid block of rosin, and take the sample for analysis in the form of two or more lumps 3 to 4 inches in diameter from approximately the center of the block.

As rosin has a marked tendency to oxidize rapidly, samples should be kept in lump form. Portions for the various determinations shall be taken from the original sample lumps, crushed, and pulverized immediately before the analysis.

A preliminary sampling of 20% of the entire lot or shipment shall be made. If the color grades of 85% or more of the number of such preliminary samples agree, with none of the samples disagreeing by more than one grade, that grade shall be accepted. If the grades of more than 15% of the preliminary samples are in disagreement, or if any are under grade by more than one grade, additional packages in the lot to make up a total equal to not less than 50% of the entire shipment (preferably the entire shipment, if accessible and not too great) shall be sampled. The findings on such larger quantity shall be accepted as the grade.

Note: The packages comprising a lot of rosin which is moving or has moved in commerce from a large concentration and distributing point may represent the production of a number of different producers from widely separated localities, and from gum collected at different seasons of the year, and may also have been graded by a number of different graders. The difficulty of obtaining a correct appraisal of the grading of an entire lot of rosin from a too limited number of samples is thus apparent.

REAGENTS

The following reagents are needed for determination of acid number, saponification number, and unsap able matter:

A. *Neutral Alcohol.* Neutralize 95% (by vo ethyl alcohol, or Formula 30 or 3A denatured al by adding a few drops of phenolphthalein solutio then 0.5 *N* NaOH, drop by drop until permar faintly pink.

B. *NaOH Solution, 0.5 N.* Dissolve 22.2 of NaOH in water, dilute to 1 liter, and standardize

C. *Phenolphthalein Indicator Solution.* Disso gram of phenolphthalein in 100 ml. of neutral alcol

D. *Alcoholic KOH Solution,* approximately 0 Dissolve 33.3 grams of stick or pellet KOH in n alcohol and dilute to 1 liter with more alcohol. off any insoluble matter.

E. *Standard Acid, 0.5 N.* Accurately standa 0.5 *N* solution of H_2SO_4 or HCl.

F. *Ethyl Ether,* anhydrous. The presence o oxides in ether constitutes a safety hazard as s explosions have resulted from laboratory wor ether containing peroxides. Test for presence o oxides as follows: Mix 5 ml. of an aqueous solut benzidine (Eastman Kodak No. 33), saturated i cold, with 5 ml. of a saturated NaCl solution. few drops of an extremely dilute, freshly pre ferrous sulphate solution (a particle of $FeSO_4$ the s a pinpoint dissolved in 5 ml. of water). Then ad 5 drops of ether to this mixture. The developmen clear blue coloration after a few minutes indicate presence of peroxides.

G. *NaOH Solution,* approximately 1%.

H. *Alcoholic KOH Solution, 0.1 N.* Dilute 20 of the 0.5 *N* KOH solution to 1 liter with n alcohol, mix well, filter off any insoluble matter standardize.

I. *Thymol Blue or Phenolphthalein Indicator tion.* Dissolve 0.1 gram of dry indicator in 100 n neutral alcohol.

COLOR GRADE

Rosin is graded according to color. The cor commercial grades, as established by the U. S. De ment of Agriculture, are, in order of increasing X, WW, WG, N, M, K, I, H, G, F, E, D, a All rosin sold in interstate commerce must be desc by reference to the above U. S. Standards for R and is, therefore, subject to grading prior to such Since rosin darkens on remelting, its color mu

determined on a cube of the material cut from a solid lump as follows:

Cut or cleave a $^7/_8$-inch cube from the original sample lump and polish the faces by a light application of a clean, heated, smooth surface (a large spatula or a heating iron). The final specimen shall have two smooth, parallel surfaces $^7/_8$ inch apart. Compare the color of the prepared cube with the Official U. S. Rosin Color Standards (obtainable on security loan from the U. S. Department of Agriculture, Naval Stores Section, Production and Marketing Administration, Washington, D. C.) or with U. S. Rosin Types (obtainable from American Turpentine Farmers Association, Valdosta, Ga., at a nominal fee). Make the comparison preferably against an open, direct-north skylight, or in a direction which excludes direct rays from the sun from passing through the rosin to the eye. The grade of rosin shall be considered that of the highest or lightest color standard which the sample equals or excels (is lighter than) in color.

ACID NUMBER

Acid number is defined as the milligrams of KOH required to neutralize 1 gram of the sample. It is determined by dissolving the sample in neutral alcohol and titrating the acidity with NaOH solution to a visual phenolphthalein end point. Potentiometric titrations may be made if desired, particularly for the darker-colored rosins.

Weigh 3.95 to 4.05 grams of freshly crushed rosin, to the nearest milligram, into a 250-ml. Erlenmeyer flask and add 100 ml. of neutral alcohol. Swirl to dissolve, warming if necessary. Cool the solution to room temperature, add 1 ml. of phenolphthalein solution and titrate with 0.5 *N* NaOH to a pink color. Calculate and report the acid number to the nearest whole unit.

Calculation:

$$\text{Acid Number} = \frac{\text{ml. NaOH} \times N \times 56.1}{\text{grams of sample}}$$

where N = normality of the NaOH solution.

SAPONIFICATION NUMBER

Saponification number is defined as the milligrams of KOH reacting with 1 gram of the sample when it is dissolved in neutral alcohol, a definite volume of alcoholic KOH solution added, the mixture refluxed for approximately 1 hour, cooled, and the excess KOH titrated with standard acid. Potentiometric titrations may be made if desired, particularly for the darker-colored rosins.

Weigh duplicate portions of 3.95 to 4.05 grams of the freshly crushed rosin, to the nearest milligram, into a 250-ml. Erlenmeyer flask with a ground-glass joint. Add 50 ml. of neutral alcohol and swirl to dissolve, warming if necessary. Pipet 50 ml. of 0.5 *N* alcoholic KOH solution into the flask, allowing the pipet to drain for a definite time. Connect the flask to a reflux condenser with a ground-glass joint and boil the solution gently for 50 to 60 minutes, starting with the point of incipient boiling. Run two blank determinations simultaneously, following the same procedure and using 50-ml. portions of neutral alcohol and 50-ml. portions of 0.5 *N* alcoholic KOH solution measured from the same pipet, allowing it to drain for the same length of time as for the sample.

Cool the solutions, add 1 ml. of phenolpthalein solution, and titrate with 0.5 *N* acid to the disappearance of the pink color. Calculate and report the saponification number to the nearest whole unit.

Calculation:

$$\text{Saponification Number} = \frac{(B - S)N \times 56.1}{\text{grams of sample}}$$

where B = average milliliters of standard acid required by blanks, S = milliliters of standard acid required by sample, and N = normality of acid.

UNSAPONIFIABLE MATTER

Caution: Because of the explosive hazard attending the use of ether, procedures involving its use should be carried out under a hood with adequate ventilation, away from open flames and exposed heating elements. Be certain that the ether is free of peroxides (*see* Reagents).

Weigh 3.95 to 4.05 grams of the sample, to the nearest milligram, into a 250- to 300-ml. Erlenmeyer flask (alkali-resistant glass preferred) with ground-glass joint, add 50 ml. of 0.5 *N* alcoholic KOH solution, connect to a reflux condenser, and boil gently for at least 30 minutes. Evaporate to about 15 ml., add 10 ml. of water, and boil gently until the odor of alcohol is gone. Transfer the solution while hot to a 250-ml. separatory funnel, A, rinsing three times with 20-ml. portions of hot water. Cool the funnel and contents under tap water and add 50 ml. of ether. Shake well, and allow the layers to separate. Draw off the aqueous layer into a second separatory funnel, B. Then add 5 ml. of water to funnel A, without shaking, and again draw the aqueous layer into funnel B.

Extract the solution in funnel B with 50 ml. of fresh ether, with thorough shaking, and, after separation, draw off the aqueous layer into a third separatory funnel, C. Add 5 ml. of water to funnel B, without shaking, and again draw the aqueous layer into funnel C. Run the ether extract in funnel B into funnel A, washing funnel B and stem with 5 ml. of ether.

Extract the aqueous solution in funnel C a third time with 50 ml. of ether, as before. Draw off and discard the aqueous portion and add the ether to that in funnel A. Add 50 ml. of 1% NaOH solution to the combined ether extracts, shake thoroughly, let separate, and discard the aqueous layer. Finally, wash the ether with two 50-ml. portions of water, discarding these wash solutions.

Draw the combined ether extracts into a 400-ml. beaker containing about 10 grams of powdered anhydrous Na_2CO_3. Rinse the funnel with 10 ml. of ether, adding this ether to the beaker. Allow the solution to stand for 10 to 25 minutes with occasional stirring. Decant about two thirds of the ether into a clean, dried, and weighed 250-ml. Soxhlet flask. Connect the flask to a water condenser by means of a one-hole rubber stopper and glass tube and distill off most of the ether on a steam bath. (The ether may be recovered for further use.) Let the flask cool and decant into it the rest of the ether from the beaker. Then break up the caked Na_2CO_3 with a stirring rod, wash it with two 15-ml. portions of ether, and decant them into the flask. Again connect the flask to the condenser and distill off the ether. Disconnect the flask and let it stand on the steam bath until the odor of ether is gone.

Dry the flask and contents to constant weight (30 minutes is usually sufficient) in an oven at 100 to 105°C. Remove from the oven, cool to room temperature in a desiccator, and weigh. Calculate the percentage of dry extracted matter.

Dissolve the extract in 50 ml. of neutral alcohol, add 1 ml. of phenolphthalein or thymol blue indicator solution, and titrate the acidity with 0.1 *N* alcoholic KOH solution. Calculate and report the percentage of unsaponifiable matter to the nearest 0.1.

Calculation:

Let E = per cent of dry extract, C = milliliters of alcoholic KOH required for titration, N = normality of alcoholic KOH, R = per cent of rosin acid in extract, and U = per cent of unsaponifiable matter.

Then

$$R = \frac{C \times N \times 30.2}{\text{grams of sample}}$$

and

$$U = E - R.$$

ASH

Ignite a porcelain, vitreosil, quartz, or platinum dish with a capacity of about 100 ml., cool in a desiccator, and weigh to 0.001 gram. Add about 10 grams of the sample, weighed to the nearest 0.1 gram, place on a ring stand in a hood, and heat gently with a Bunsen burner until the rosin can be ignited at the surface. Remove the burner and allow the rosin to burn, reheating only as necessary to maintain a moderate flame. When the flame finally dies out, increase the heat and burn off the bulk of the carbon. Finally, ignite in a muffle at 500 to 550°C. until the carbonaceous matter has been consumed. Carefully transfer the dish from the muffle to a desiccator, cover with a platinum cover, cool, remove the cover, and weigh the dish and contents to the nearest 0.001 gram. Calculate the percentage of residue and report as ash to the nearest 0.01.

TOLUENE-INSOLUBLE MATTER

This determination indicates the amount of sand, chips, dirt, bark, etc. Pulverize about 200 grams of the representative material to pass a 10-mesh sieve immediately before the determination is made, and mix thoroughly. Weigh about 50 grams, to the nearest 0.1 gram, of the pulverized sample into a 400-ml. beaker, add 150 ml. of industrial-grade toluene and dissolve by warming and swirling. When the rosin has dissolved, filter at once by suction through a dried and weighed Gooch crucible containing an asbestos mat. Wash the crucible and contents thoroughly with fresh, hot toluene, dry to constant weight at 105 to 110°C. (1 hour usually suffices), cool, and weigh. Calculate the percentage of toluene-insoluble matter and report to the nearest 0.1.

ADDITIONAL INFORMATION

The principal changes in this revision as compared to the previous method are:

1. In the determination of Color Grade the sample cube is cut to size instead of melting and casting the rosin.

2. In the determinations of Acid Number and Saponification Number the weight of sample is increased to give greater precision. Certain other chang technique are included and potentiometric titrat suggested for dark-colored rosins.

3. In the determination of Unsaponifiable M the reflux time is cut from 2 hours to 30 minutes correction for rosin acid in the residue is made. alternative treatment with Na_2CO_3 solution is dro

4. In the determination of Ash the sample creased to 10 grams and a definite ignition tempe is specified.

RECENT BOOKS

Organic Coating Technology. Vol. I. By Fleming Payne, Technical Editor, American Cya Co., New York, 1954. John Wiley & Sons, Inc., Cloth, 6 × 9, 674 pages. $10.

Volume I of "Organic Coating Technology" deals the chemistry, manufacture, and application of oils, varnishes, and polymers of special interest to pain varnish manufacturers. The two volumes are w to outline the theory and practice regarding organic ings.

Among the subjects covered are fundamentals o formation, vegetable and marine oils, varnish driers, volatile solvents, alkyd resins, urea- and mela formaldehyde resins, rubber resins, plasticizers, cel polymers, vinyl resins, acrylic ester resins, silicone and test methods.

Chamber's Shorter Six-Figure Mathematical T By L. J. Comrie, Scientific Computing Service Chemical Publishing Co., New York, 1954. $6^3/_4 \times 9^3/_4$, 387 pages. $6.50.

The first volume of Chamber's "Mathematical T appeared in 1884 with 316 pages. From time to tim volume has been enlarged by various compilers u reached 1200 pages in two volumes. The new volu 387 pages represents, in the author's opinion, a suff amount of data for common use.

Among the subjects covered are logarithms of num logarithms of trigonometrical functions of angles i grees, minutes, and seconds, trigonometrical functio angles, circular functions, exponential and hype functions, powers, roots, reciprocals, factors, and torials, prime numbers, numerical differentiation, num integration, conversion tables, and proportional pa

Toxicity of Industrial Organic Solvents. By Ethel B ing. Chemical Publishing Co., New York, Cloth, 6 × 9, 411 pages. $8.00.

The present volume was prepared for British Home by the Medical Research Council to report on the h factors involved in handling various volatile subst used industrially as solvents and frequently in quantities.

The principal products covered are hydrocar chlorinated hydrocarbons, alcohols, ethers, esters, ke glycols and their derivatives, amines and coal tar nitro compounds, and miscellaneous compounds. of these main dimensions are subdivided giving ful

sideration to specific materials such as benzene, toluene, xylene, etc.

Details are given relative to concentration in air risk of explosions, estimation in air, industrial processes, estimation in blood and tissues, toxic effects, symptoms.

Laboratory Instruments. By A. Elliott, Courtaulds, Ltd., and J. Home Dickson, Royal Naval Scientific Service. Chemical Publishing Co., New York, 1953. Cloth, $5^1/_2 \times 8^1/_4$, 414 pages. $7.50.

A book devoted to the design and application of laboratory instruments to assist research workers who need to build their own instruments. The chief aim of the book is to present the principles on which good design is based. The first few chapters deal with the properties of various materials and their treatment and use in the construction of instruments. One chapter deals with the preparation of drawings for the workshop and succeeding chapters are devoted to methods of construction to suit special requirements. Special attention is given to kinematic design of instruments. Chapters on vibration, insulation, sensitivity, and methods of measurement follow. Other chapters relate to optical instruments, glass working, and photography.

The book is amply illustrated and should be of great value to any research laboratory organization.

Abreit au der Papiermaschine. By Karl Theodor John Darmstadt. Edward Roether Verlag, Germany, 1954. Cloth, $6 \times 8^1/_4$, 317 pages. $6.20.

A textbook printed in German covering the processes of paper manufacture. The first chapter deals with the raw materials, pulps, size, colors, etc., used in papermaking. Chapter II is devoted to the paper machine which is followed by chapters on auxiliary equipment, general notes, and physical and chemical tables.

Although the book covers the subjects usually found in textbooks on papermaking, it should be included in every papermaker's library since it contains many details of considerable value not usually found in papermaking volumes. Since the book is devoted almost entirely to the machine room, much useful information relating to the actual papermaking operation is offered.

Forest Products Research and Industries in the United States. By W. W. Varossieau, FAO United Nations. J. M. Meulenhoff (Beulingstraat 2), Amsterdam, Holland, 1954. Cloth, $7 \times 9^1/_2$, 796 pages. $10.50.

A comprehensive study of forest products research and industries made under the auspices of the Technical Assistance Branch of the European Recovery Program.

The report is divided into several parts: (1) Object of the Visit and Itinerary; (2) Forest Resources, Damage and Losses, Reforestation, Harvesting, Logging and Transport to Mill; (3) Sawmills, Timberyard Practice; (4) Wood Preserving Industries; (5) Plywood and Allied Products; (6) Derived Products and By-Products Industries. In this chapter 65 pages are devoted to pulp and paper, giving location and capacity, data, the manufacturing processes for pulp and paper and wood species used, pulp, paper, and board properties, pulp and paper consumption, and uses of special types of pulp and paper. The balance of this chaper is devoted to wood-waste utilization and utilization of bark and extractives.

Note: The books reviewed in these columns may be obtained from the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

EMPLOYMENT SERVICE

Positions Wanted

E265-54. Superintendent. A practical papermaker, with a proved background on cylinder specialties. Capable of upgrading a mill to produce quantity and quality on modern seven or eight cylinder machines. Possesses a technical as well as a practical training. Middle aged.

E266-54. Man with excellent experience in process, product, and engineering development desires responsible position in such activities. Can offer broad background in pulp, paper, polymers, and chemicals.

E267-54. Young man, 28 years, married, experienced in quality control, product development, and management, desires new position.

E268-54. Position wanted as Superintendent, Assistant Superintendent, or Technical Director. Considerable experience on Yankee and fourdrinier specialties such as carbonizing, fruit wraps, waxing, bag and bond grades, etc. Also some experience on strawboard, roofing grades, clay-coated board and pulping of agricultural residues, grasses, etc. Chemical engineer. Married. Age 39. Prefer *Foreign* or West Coast location. Available on short notice.

Positions Open

P363-54. Paper Salesman. Established manufacturing concern desires young man between 30 and 35 years of age to sell chemical specialties to paper industry. Qualifications must include experience in technical or production end of paper industry. Chemical background essential. Excellent opportunity for man demonstrating initiative and sales ability. Please give details of education, experience, and salary desired.

P369-54. Chemist or Chemical Engineer with experience in paper chemistry, laboratory scale production, and evaluation. Give full details of experience with reply.

P372-54. Chemist or Chemical Engineer with experience in kraft board industry for the position of chief chemist with progressive southern mill. Must be qualified to supervise entire technical department engaged in quality process control, product and process development, water treatment, and control of stream pollution. Include outline of personal data, education, experience, and salary desired in initial reply.

P373-54. Executive Salesman for midwest mill manufacturing semichemical board and boxes. Technically trained man preferred.

P374-54. Plant Engineer or Assistant Plant Engineer for tissue and fine paper mill in the east. Man with paper industry experience preferred.

P375-54. Man with some paper mill experience, preferably in the board industry, for position in midwest corrugated and fiber shipping container mill, to work on mill problems, development work, etc., involving color formulation for coating work.

P376-54. Assistant to Paper Mill Superintendent, about 35 years of age, having preferably a chemical engineering degree and some papermaking experience to train for position as assistant superintendent in mill located in the east making packaging and fine papers.

WANTED

Chemist or Chemical Engineer

Opportunity available for Chemist or Chemical Engineer in a mill making Bleached Soda and Sulphite Pulp, also Chlorine and Caustic. Mills located in Maine. Send résumé of educational background and experience. Experience desirable but not necessary. Address reply to Penobscot Chemical Fibre Company, Great Works, Maine. (P377-54)

Miscellaneous

A5-54. For sale, Laboratory beater, 10-lb Dilts, with washer and motor. Excellent condition. A. B. Dick Co., 5700 W. Touley St., Chicago 31, Ill.

A6-54. Belgian firm importing raw materials for paper mills in Belgium, France, and Switzerland desires to act as agent for American firm selling various grades of wood pulp.

Note: Responses to advertisements appearing in this column should be addressed to the box number indicated % *Tappi*, 155 E. 44th St., New York 17, N. Y.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Delaware Valley

The Delaware Valley Section met at the Engineers Club, Philadelphia, Pa., with 80 members and guests present. Chairman Frank Lovegren opened the meeting and, after brief business announcements, turned the meeting over to Emil Padavic, program chairman, who introduced the speaker, J. N. McGovern, chemical engineer, Forest Products Laboratory, Forest Service, United States Department of Agriculture, Madison, Wis. Mr. McGovern spoke on "Semichemical Pulping Advances."

Semichemical Pulping Advances

J. N. McGovern

SEMICHEMICAL pulping has undergone an interesting historical development and is presently a dynamic factor in the pulp and paper industry. It has fitted well into the remarkable change in pattern of this industry in the last 12 years. The extent of this change and the basic facts about semichemical pulping, however, are not so widely known as might be possible. The purpose of this talk, therefore, is to provide information on the following factors pertaining to semichemical pulping: (1) definitions and scope, (2) history, (3) industry development and relations to other processes, (4) fibrous materials, (5) pulping procedures, (6) manufacturing practice, (7) pulp properties, and (8) products.

DEFINITIONS AND SCOPE

Semichemical pulping is a multistage process involving chemical treatment of a fibrous raw material to obtain a softening and partial removal of the bonding material, followed by a mechanical treatment to complete the fiber separation. The chemical part of this definition can be interpreted to include practically any process between chemical and groundwood pulping. A possible classification of pulping processes on the basis of yield is given in Table I. The high-yield, coarse-fiber, and Chemigroundwood processes are arbitrarily excluded from consideration in this discussion mostly on the basis of operation and product. Even with this limitation the field of operation covers a wide nominal yield range of about 65 to 90%.

The second part of the semichemical process, the fiberizing, is defined as the mechanical treatment applied to resolve aggregates into a fibrous state. In distinction, the mechanical treatment given the fiberized pulp for the purpose of developing its strength or other desired properties is the definition for refining. It is obvious that in practice it is practically impossible to separate fiberizing and refining. In fact, it is sometimes desirable and advantageous to perform the two actions in one operation.

The cold soda process, which has attracted considerable attention in the last few years, is a type of semichemical process according to the preceding definitions and is generally considered as such for purpose of simplification in this report. However, it has certain unique features distinguishing it from the processes generally classed as semichemical. ' features include the possibility of conducting the p with concurrent chemical and mechanical treatments an possibility of producing groundwood-type pulps from of the hardwoods of this country.

HISTORY

The first semichemical pulp mill was established in This was the mill of the Southern Extract Co., Kno Tenn., which used chestnut chips from which the t had been extracted for pulping by the neutral sodium su process. The operating conditions for this mill were oped by experiments started at the Forest Products L tory in 1921 and which resulted in the classical publi by Rue, Wells, Rawling, and Staidl in 1926. That sam public patents were applied for, which were granted in However, the semichemical pulping idea had been sug in 1874 by Mitscherlich in a process of softening with sul ous acid and bisulphites followed by rubbing or grind produce a pulp. Another historically related date is when C. F. Cross of Cross and Bevan fame reported th of sodium sulphite as a pulping agent.

Although a practical application of semichemical p had been established by 1925, a U. S. patent of 1928 by ing (no. 1,673,089) is interesting because it summariz principles of the modern approach to semichemical pu including steaming to remove the air from the chips and ing in the vapor phase.

About this same time, a patent was granted to Traqua Rawling which is basic to a segment of the present sem cal industry. This U. S. patent of 1932 (no. 1,84 covered the idea of the continuation of the removal fiber-bonding material started in the semichemical p by delignification with chlorine and bleaching in the stage process. This, of course, is the base for preser production of bleached semichemical pulp.

A big impetus was given to semichemical pulping 1944 by the conversion of a kraft mill of the Southern Corp. at Bastrop, La., to this process. The mills up t time had capacities under 100 tons per day. The B mill was rated at 200 tons at the start and is now ra more than double this figure.

Also of note in 1944 was the installation of a conti semichemical digester of the horizontal-reactor-tube t the Covington, Va., mill of the West Virginia Pulp & Co. Since then, in the semichemical field there have the rapid, successive introduction in 1949 of bleached chemical pulp production at the Consolidated Water & Paper Co., Wisconsin Rapids, Wis., cold soda pulping at the Green Bay Paper & Pulp Co., Green Bay, W 1951 following the development experiments at the Products Laboratory, and finally the application of th tinuous reactor tube for making semichemical pulp for b ing last year. The idea of the cold soda process actual proposed as early as 1919 by E. Oppermann in Germa 349,880.

DEVELOPMENT OF THE SEMICHEMICAL PU INDUSTRY

The semichemical industry has displayed a solid patt

J. N. McGOVERN, Chemical Engineer, Forest Products Laboratory, maintained at Madison, Wis., in cooperation with the University of Wisconsin, Forest Service, U. S. Department of Agriculture.

Table I. Yield Relations Between Various Pulping Processes

	Process	Yield, %
1.	Standard	
	Groundwood	90–95
	Soda, sulphite, sulphate	40–50
2.	High-yield	
	Sulphite, sulphate	50–65
3.	Semichemical	
	Neutral sulphite, kraft, acid sulphite	65–85
	Cold soda	85–90
4.	Chemigroundwood	85–90
5.	Coarse fiber	
	Asplund, Masonite, steam, mild chemical	70–90

growth of capacity to produce pulp after slow start, as shown in Table II. The first mill, established in 1925, had the modest capacity of 10 tons. By 1930, the daily capacity had grown to 355 tons. Most of this tonnage was pulp for the historical chestnut-chip 9-pt. The depression years apparently had their effect on the semichemical industry, as there was little growth between 1930 and 1940. However, the daily capacity doubled between 1940 and 1945 to approach the 1000-ton mark. Then the idea really took hold with the resultant rather spectacular growth in recent years. This has brought the count up to this time, as closely as can be determined, to 34 mills with a total capacity of close to 4200 tons of semichemical pulp per day. If the present trend is continued, a daily capacity of 7000 or 8000 tons might be expected by 1958.

The capacity data in Table II are broken down into figures for mills making pulp for board and for paper. The pulps made for paper are all bleached. The recent growth of this segment of the semichemical industry is marked. It is expected that eventually there will be a substantial production in this field.

The first semichemical mill was established in Tennessee to utilize the spent chestnut chips. The next few mills were established in Tennessee, Virginia, and North Carolina, primarily to take advantage of the spent chestnut chips. Since the thirties, however, semichemical mills have been established in all the major pulping areas, except the Pacific Northwest, as shown in Table III. The semichemical pulping industry also has spread to Canada, Scandinavia, France, Germany, and Japan.

FIBROUS MATERIALS FOR SEMICHEMICAL PULPING

Semichemical pulp is made in this country predominantly from the hardwoods. (The term "hardwoods" is meant here to be the short-fibered wood from deciduous or broad-leafed trees.) This largely explains the absence of a mill in the Pacific Northwest. Nevertheless, there apparently is enough red alder seriously needing utilization from a forest-management standpoint to point to an operation or two in this area.

Table II. Daily Semichemical Pulp Capacity

Year	Board mills — No.	Board mills — Amount, tons	Paper[a] mills — No.	Paper[a] mills — Amount, tons	Total Amount, tons
1925	1	10	..	...	10
1930	5	320	1	35	355
1940	7	415	1	50	465
1945	10	925	..	...	925
1947	12	1490	..	...	1490
1948	15	1955	3	80	2035
1950	17	2115	3	110	2225
1951	19	2610	4	130	2740
1952	20	2910	7	295	3205
1953	23[b]	3190	9[b]	380	3570
1954[c]	25[b]	3810	9[b]	380	4190

[a] Bleached products, specialty boards, and papers.
[b] Includes one mill with both board and paper facilities.
[c] Estimated capacity, January, 1954, includes two mills scheduled to start up.

Table III. Location of Mills with Semichemical Pulping Facilities[a]

East
- New Hampshire—1
- New York—1
- Pennsylvania—2

Lake States
- Michigan—3
- Minnesota—1
- Wisconsin—5

South
- Louisiana—2

Central States
- Ohio—2

South Atlantic
- North Carolina—2
- South Carolina—3[b]
- Virginia—1
- Georgia—1[b]

Appalachian
- Tennessee—3
- Virginia—3
- North Carolina—2

West
- California—1

[a] Commercial-size equipment with daily capacity of more than 10 tons of semichemical pulp.
[b] Includes a mill scheduled to start up in 1954.

The hardwoods, it has been found, are particularly well suited for semichemical pulping. This process brings out property values in the pulps that are greater or unique in comparison with hardwood pulps obtained with other methods. This favorable behavior is coupled with the extremely favorable economic advantage of a low wood cost per ton of pulp to make a very attractive proposition. This is not generally the case with softwoods within the limits of the original definitions of semichemical pulping. Examples of some of the unique properties are illustrated in those of hardwood semichemical corrugating board and bleached hardwood semichemical greaseproof and glassine papers.

Most of the important hardwoods in this country have been proved by experiment, pilot-plant demonstration, or commercial use as suitable for semichemical pulping. Hardwoods can be conveniently classified into three groups, mostly on the basis of occurrence and pulping practice. These are: (1) the light-colored, low-density woods like aspen and cottonwood, (2) the so-called "soft" hardwoods that are typified by birch and soft maple in the northern forests and sweetgum and the tupelos in the southern forests, and (3) the heavy hardwoods exemplified by the oaks and hickory. The first two types have been favored, but the oaks have been increasing in use and show promise for increased utilization.

The use of the widely available hardwoods through the semichemical approach is an important factor in the problem of meeting our fiber requirements. In this connection, there has been an impressive increase in hardwood usage as shown in Table IV. There was a four-fold increase between 1935 and 1952, and the increase between 1945 and 1952 was about 60%.

On a percentagewise basis, the increase in hardwood pulpwood use has been greater than either southern pine or other softwoods since 1940, as shown in Table V. Although hardwoods supply only about 15% of the national consumption of pulpwood, it is interesting to note that in 1952 their consumption was more than 35% of the combined consumption of northern and western softwoods.

The distribution of hardwoods used by the various processes and the interesting change in the pattern of distribution since 1940 are shown in Table VI. As recently as 1940, the bulk of the hardwoods, about 80%, went into their traditional outlet, the soda pulp industry. About half of the remainder entered the budding semichemical industry. A sur-

Table IV. Hardwood Pulpwood Consumption in United States

Annual consumption, cords

Year	Amount
1930	900,000
1935	900,000
1940	1,200,000
1945	2,400,000
1950	3,200,000
1952	3,800,000

Table V. Pulpwood Consumption

Kind	1000 cords 1940	1952	Change, %
Hardwoods	1,200	3,800	317
Southern pine	5,000	13,000	260
Other softwoods	7,500	9,700	130
	13,700	26,500	193

prisingly small percentage of hardwoods was made into sulphite, sulphate, and groundwood pulps.

Between 1940 and 1952 there was a striking change in the use of hardwoods. Their use for soda pulping decreased because of lowered production, but in other processes there use increased, most importantly in the semichemical process, and in the newly introduced processes, as shown in Table VI. Thus, their use in soda pulping, which shrank to 22%, was exceeded by the semichemical process where their consumption rose to 24%. Their increased use in making sulphite and groundwood pulps is largely an unpublicized development. The increase in hardwood use by the sulphate and coarse-fiber processes and the indication of advancements in the newer Chemigroundwood and cold soda processes pressage a good future for these woods. The expected proportional trend in hardwood usage for pulp and paper relative to the present time is shown in the last column of Table VI.

The increase in production of the high-yield pulps in comparison with the decrease in soda pulp as examples reflecting the changing pattern of wood pulp production is shown in Table VII. Proportionately, the semichemical and coarse-fiber (defibrated) industries have increased more than even the sulphate. The only other major segment, in addition to the sulphate industry, showing an increase greater than the over-all change is the dissolving-pulp industry. The time-honored sulphite and groundwood processes showed increased productions from 1940 to 1952, but below the over-all rate of increase.

PULPING PROCEDURE

Chemical Stage

The stage of semichemical pulping described in the definition as having the purpose of softening and partial removal of the bonding material can be conducted with any pulping reagent. Thus, the conventional soda, sulphate, or sulphite pulping liquors can and have been used. Sodium hydroxide at room conditions has also been demonstrated as a possibility. However, the reagent mostly used is sodium sulphite. About 90% of the semichemical mills in this country employ a sodium sulphite liquor at high temperatures and pressures and the remainder use a weak sulphate pulping liquor. The sodium sulphite is generally used with a buffering agent to keep the pH above 7 and, hence, the name, "neutral sulphite pulping." The buffering agent may be sodium carbonate,

Table VI. Hardwood Use for Pulping

Process	1940, %	1952, %	Expected proportional trend
Semichemical	12	24	Increase
Cold soda	...	[a]	Increase after establishment
Soda	80	22	Decrease
Sulphite	8	17	Decrease
Groundwood		17	Decrease
Chemigroundwood	...	[b]	Increase
Sulphate	[c]	12	Increase
Prehydrolysis	...	4	Increase
Coarse fiber	...	4	Increase
	100	100	

[a] A small amount has been made commercially, but apparently no production at present.
[b] A small amount, less than 1% of hardwoods consumed, was made commercially in 1953.
[c] Included in sulphite and groundwood figure.

Table VII. Wood Pulp Production

Grade	Production (1000 tons) 1940	1952	Change[a], %
Sulphate	3748	8,568	229
Groundwood	1633	2,380	146
Sulphite	2281	2,365	104
Defibrated	210	1,058	503
Semichemical	165	821	498
Dissolving	327	706	216
Soda	532	425	80
Others	64	140	219
	8960	16,463	184

[a] Based on 1940 production as 100.

sodium bicarbonate, sodium hydroxide, or even kraft liquor. The main reactions in neutral sulphite pulpi the neutralization of the acetyl groups with the buff sulphonation of the lignin.

The chemical requirements vary according to the used, the amount of pulping (that is, the yield), and th ess. The ranges of chemical usage for neutral su semichemical pulping are given in Table VIII. The ch consumption can be quite high on a wood basis if a l able pulp is being made from woods with a relativel chemical requirement, sweetgum and red alder, for ex The high chemical requirements appear less disadvant when calculated on the basis of the pulp, as also sh Table VIII, because of the high yield of pulp.

Other conditions for semichemical pulping are gi Table VIII.

In the cold soda process the chips are treated for 1 t at room temperature in a sodium hydroxide solution o 75 grams per liter concentration.

The chemical requirements for pulping by the variou esses on a common base of sodium oxide are given in IX. The semichemical processes have a lower ch requirement on this basis than the alkaline process higher than the sulphite process. The requirements the several semichemical processes are of the same or all. When the pulp is used as the basis for compari semichemical requirements are much lower than f sulphate and soda pulping. This comparison is, o academic because the chemicals are recovered in so sulphate mills. Presumably, if semichemical spent were treated for chemical recovery, the amount of m chemicals on a pulp basis would be less than that for n sulphate-mill practice because of the higher semich pulp yield.

Table VIII. Semichemical Pulping Conditions for woods

	Board pulp	B
Neutral Sulphite Process		
Pulp yield, % of wood	70 to 80	6
Cooking chemicals		
Sodium sulphite, % of wood	8 to 14	1
Sodium bicarbonate, % of wood	4 to 5	
Chemical requirements		
Sulphur, lb. per air-dry ton of pulp	7	
Soda ash, lb. per air-dry ton of pulp	262	
Cooking temperature, °C.	150 to 185	16
Time at cooking temperature, hr.	0.3 to 4	
Energy for fiberizing, hp.-days per air-dry ton of pulp	12 to 18	1
Sulphate Process		
Pulp yield, % of wood	70 to 75	
Cooking chemicals		
Sodium hydroxide and sodium sulphide, % of wood as sodium oxide	4 to 7	
Cooking temperature, °C.	160 to 185	
Time at cooking temperature, hr.	0.3 to 2	

Table IX. Relative Chemical Requirements for Pulping

Process	Amount of Na_2O	
	100 lb. wood, lb.	Air-dry ton pulp, lb.
Semichemical		
Cold soda	4.4 to 7.8	90 to 160
Neutral sulphite	5.8 to 10.9	130 to 290
Kraft	7.8	190
Soda	7.8	190
Sulphate	13.3 to 21.5	500 to 900
Soda	19.5	800
Sulphite	4.4	170

In the past, it was economical and permissible to discharge semichemical spent liquor as an untreated mill effluent. It now seems doubtful if it is economical to throw away the large quantity of chemicals needed for making bleaching-grade pulp, but more important restrictions against stream pollution made it increasingly difficult to operate that way. Neutral sulphite semichemical spent liquor has a substantial pollutional (B.O.D.) value, that ranges roughly from 100 to 200 p.p.m. per ton of pulp produced, depending on pulp yield. This compares with 500 p.p.m. for sulphite pulp and 50 p.p.m. for sulphate pulp production.

There is an impressive amount of work being done to develop a method for recovering the valuable chemicals in semichemical spent liquor and at the same time eliminate stream pollution. Several mills have solved the problem by using the spent liquor as chemical makeup in the recovery system of an associated kraft mill. Other mills have recovery systems of several types under trial.

Mechanical Stage

The resolution of the softened chips into a fibrous state or pulp is considered by many to be the heart of the semichemical process. This mechanical action was first proposed to be done in rod mills, kollergangs, and the like, but practically all fiberizing is now performed in disk mills. These can be single or double-rotary disks that can be operated under pressure or not. The fiberizing can be done in single or multipass operations. Recent experiences with pressing of the cooked chips before fiberizing for liquor recovery have given promise for other advantages. There is a reduction in particle size to give a uniform product for feeding the primary fiberizer along with advantages in reduced total energy and improved pulp quality.

The energy for fiberizing the chips to a well-defined pulp ranges from about 10 to 20 hp.-days per ton of air-dry pulp for the neutral sulphite and sulphate semichemical processes and 20 to 30 hp.-days for the cold soda process.

BLEACHING PROCEDURE

Suitable semichemical pulps are bleached by conventional single and multistage procedures. The single-stage bleaching with calcium or sodium hypochlorite or peroxides is applied to neutral sulphite semichemical and cold soda pulps to give brightness values of 65 to 75% with a shrinkage of 2 to 4%. In the case of hypochlorite bleaching, the bleaching chemical

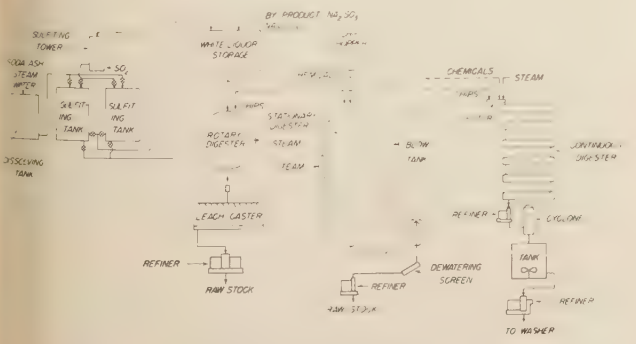


Fig. 1. Semichemical pulping flow sheet

Table X. Semichemical Pulp Properties

Strengths relative to softwood sulphite of bond grade

Pulp	Strength property[a]			Sheet density
	Burst	Tear	Fold	
Softwood sulphite	100	100	100	100
Unbleached semichemical	50 to 90	90 to 120	10 to 50	60 to 80
Bleached semichemical	90 to 120	100 to 140	20 to 75	80 to 100

[a] Pulps at freeness of 300 to 500 ml. (Canadian Standard).

requirement in terms of chlorine equivalent is about 10% of the unbleached pulp.

Multistage bleaching is only applied to neutral sulphite pulps and generally includes chlorination, alkaline extraction, and oxidation stages. The total chlorine consumption is 12 to 20% of the unbleached pulp, the brightness is in the range of 75 to 85%, and the shrinkage is 15 to 20% to give bleached pulp yields of 53 to 60% based on the weight of moisture-free wood.

SEMICHEMICAL PULPING PRACTICE

The equipment and flow of materials in neutral sulphite and kraft semichemical pulp manufacture are shown in Fig. 1. In the neutral sulphite process, the sodium sulphite may be purchased as a by-product chemical, together with market soda ash, or other buffering material, or the cooking liquor may be made in the mill by sulphiting soda ash. The kraft semichemical mills use a weak white liquor, usually obtained from an associated kraft mill. There are three types of digesters in general use, although others are under development. Those used in a number of mills are the spherical rotary, vertical stationary, and the continuous-tube digesters. The methods and equipment for discharging the softened chips, conveying and fiberizing and refining also show a wide diversity. The industry is still in a stage of development.

The equipment and flow for cold soda pulping are quite similar to those for semichemical pulping although a pressure-treating vessel may not be necessary.

The bleaching of suitable semichemical pulps is done with conventional equipment. It may be necessary to have larger washing capacity for semichemical than chemical pulp.

SEMICHEMICAL PULP PROPERTIES

The properties of unbleached neutral sulphite semichemical pulps are presented by comparison with a softwood sulphite pulp of a good bond grade in Table X. If the properties of the sulphite pulp are taken as 100%, then unbleached semichemical pulps will have 50 to 90% of the bursting strength, 90 to 120% of the tearing resistance, 10 to 50% of the folding endurance, and the sheets will be more bulky. The range of semichemical values is due mostly to the species used, but also in part to the yield of the pulp. The semibleached or brightened pulps have the same to slightly higher strengths compared with the unbleached pulps.

Cold soda pulps have properties falling between the upper

Table XI. Products Using Semichemical Pulps

Unbleached	Bleached
Present Use	
Corrugating board	Book, magazine (coated and uncoated)
Specialty board	Bond, writing, etc.
Newsprint	Glassine, greaseproof
Wrapping	Food board
	Specialty boards
Possibilities	
Liner	Waxing, carbonizing
Toweling	Toweling, tissue
	Dissolving

range of softwood groundwood pulps and the lower range of hardwood semichemical pulps. However, hardwood cold soda pulps may be made to resemble softwood groundwood pulps more closely than has been done with semichemical pulps.

Full bleaching, in which the lignin in the unbleached pulp is removed, causes an appreciable increase in strength (Table XI). The level of strength is the same or higher than the softwood sulphite, except for lower folding endurance. The bursting strength of the bleached hardwood semichemical pulps may be as high as bleached southern pine sulphate pulp. The data on tearing resistance need qualifying to note that this strength property will be higher in the unrefined softwood sulphite pulp than in the semichemical pulp. The bleached semichemical pulps show a certain range in properties due, again, to the wood used.

The brightness of the unbleached pulps will depend on the wood used, the yield, and the pH at the end of cooking. The range is 40 to 55%. The brightened pulps, as mentioned before, will be in the range of 65 to 75%, and the fully bleached pulps nominally from 75 to 85%.

Since practically all of the semichemical pulps are made from hardwoods, they are necessarily short-fibered. As such, they tend to have low wet-web strength and possibly to drain somewhat slowly. Developments in pickup arrangements may solve the low wet-strength problem.

Because their manufacture involves a mechanical fiberizing step, semichemical pulps tend to contain shives and other objectionable matter. Here again, equipment developments such as centrifugal cleaners and prefiberizing give promise of solving this problem.

The unbleached pulps also tend to be stiff and hard. This is the reason for their usefulness in making corrugating board. These pulps also lack opacity. However, when blended with other pulps both their hardness and lack of opacity do not seriously affect the resultant mixture. The bleached pulps are softer and more opaque than the unbleached, but still may be too stiff for some uses. The bleached pulps also blend well with other pulps. The semichemical pulps retain fillers well. Semichemical papers have good printing characteristics.

The semichemical pulps can often be used with little or no refining. They generally refine rapidly.

USES FOR SEMICHEMICAL PULP

The present and some possible uses for semichemical pulp are shown in Table XI. In a few of these uses semichemical pulps may be limited to application in amounts less than 40 or 50%. On the other hand, it would seem possible to use some semichemical pulp in practically all the grades of paper now manufactured.

Semichemical pulp is presently used only in integrated operations. There is no market pulp. However, some semichemical pulp is shipped as wet lap in an integrated organization. Interest is being shown in the manufacture of semichemical pulp for the market.

Meeting of March 25, 1954

The Delaware Valley Section met at 6:30 p.m. at the Engineers Club, Philadelphia, Pa. Over 70 members and guests were present. Chairman Frank Lovegren opened the meeting and introduced Walter Bloomquist of the TAPPI Engineering Division, who spoke to the Section on the coming (next fall) meeting in Philadelphia. Mr. Lovegren assured the fullest cooperation of the Delaware Valley Section, and solicited volunteers to help organize the affair. R. G. Macdonald (Secretary of National TAPPI) spoke briefly on the Engineering Conference. Mr. Lovegren reported on the chairman's meeting in New York which he and Emil Padavic attended. He announced that Ward D. Harrison (Riegel Paper Corp.), a member of our Local Section, is now the National TAPPI Council member for Local Sections.

Carl Ackerman (Union Mills Paper Co.) spoke on the importance of routine control methods, and asked for suggestion of any method members might consider of value.

Mr. Lovegren announced the coming election of officers and then turned the meeting over to Program Chairman Emil Padavic, who introduced Loren B. Sjöström (Arthur D. Little, Inc.), who spoke on "Odor Control in the Paper Industry."

Odor Control in the Paper Industry

Loren B. Sjöström

The drugstore and the corner grocery are daily testimonials to the utility and versatility of paper packages. Pharmaceutical and food products. Row on row of brightly printed cartons bear witness to the fact that both the manufacturer and the consumer have voted yes to paper containers, because of their economy, cleanliness, and convenience, and because of their attractiveness. A well-designed package is such a good salesman for food that (I believe it is safe to say this) most *first* sales in today's supermarket are made on the basis of eye appeal.

Repeat sales, however, depend on the quality of the contents of the package (*1*). Here, the pulp, paper, and package manufacturers, as well as the food industries, must be on guard. For there do exist a few instances where the package that sells the product to the consumer initially proves to be the culprit that scalps the product in terms of repeat sales. I am speaking, of course, of instances where odors in packaging materials become contaminants of the package contents through odor transfer (*2*).

Such occurrences can be prevented. I am sure that those you present here have taken steps to prevent them. For both paper, and package suppliers have recognized the fact that their products must meet the standards for nose as well as eye appeal. And many have acquired the services of odor experts to be responsible for approving the materials as they reach the plant; to check on the finished products before they are shipped; and, where there is a problem, to track down its source and eliminate its cause (*3*). This is not as easy as it sounds— for odor problems like odor itself, are complex and elusive.

THE NATURE OF ODOR PROBLEMS IN FOOD PACKAGING

Odor is that property of a substance that can excite the sense of smell. It is generally believed that odor is caused by molecules of odorous chemical elements or compounds dispersed in the air. For a paper product to be odorous it must contain an odorous chemical substance that volatilizes and disperses. An incredibly tiny amount of some odorous substances can create a sizable smell (*4*, *5*).

Because odors are molecules of volatile substances in the gaseous phase, odors emanating from one substance can condense on another substance and be ad- or absorbed. Thus odor transfer can take place by contact or over long distances. It is through odor transfer that food products contained in odorous packages become contaminated; the sorption of odor by the food can alter the flavor of the food considerably, as flavor is made up largely of odor, or aromatic, notes (*6*).

An odor may be traced to one of the basic ingredients of a product; to a foreign substance that has entered the product; or to an odor that the product has ad- or absorbed from other odorous materials. What is thought to be a single odor with a single source may turn out to be a composite of several odors with various sources.

Because of these elusive and complicated qualities of odor, the odor expert must, in examining a package for odor

Loren B. Sjöström, Arthur D. Little, Inc., Cambridge, Mass.

separate tests on the various parts of the package: the overwrap; the several layers of board; the corrugating material; and the liners. He must consider as possible sources of odor: the basic paper stock, the ink, the adhesive, the coating, or a perfume additive. He must explore as possible causes of odor the actual processes of papermaking, package manufacturing, and printing as well as situations where an odor may have been acquired from a containing carton or from the atmospheres of the warehouse or retail store through sorption (7). And he must entertain the idea of possible combinations of these factors.

TECHNIQUES OF EXAMINING ODOR IN PAPER SAMPLES (2, 3)

The same volatility that makes odors complex and elusive aids the odor expert in pinning down an odor by providing him with excellent techniques for odor examination.

In the Arthur D. Little Flavor Laboratory, we usually follow a standardized procedure in testing food-package samples. First, the odor and flavor of the food product itself are analyzed. From this, we find out the extent to which the food has been contaminated and are able to get some idea of the nature and possible source of the contamination. After this first step, we test the package (entire and/or stripped down into its parts) by several techniques: the free smelling test; the water-soaking test; the oil and water test; and the butter and chocolate tests.

Free-Smelling Test

In the free-smelling test, the sample is sniffed dry; then it is lightly wetted in various areas, and the vapor is sniffed to check for odor. (For moistening, an ordinary letter-moistener is suitable and convenient.)

The principle behind this technique is that of steam distillation; the water on the wetted surface evaporates and takes with it the odorous molecules, thus emphasizing the odor. This test is extremely useful for the screening of a large number of samples.

Water-Soaking Test

In the water-soaking test, strips of the sample are placed in an odor-free glass bottle, which is then half-filled with distilled water, covered, and allowed to stand for 24 hr. During this period, the volatile substances accumulate in the bottle. After this period, the bottle is sniffed and the accumulated odors noted.

This test, which unfailingly confirms evidence from the free-smelling test, also sometimes reveals other odors. It is especially convenient for the comparison of several samples.

Oil and Water Test

A still more sensitive test is based on the high sorption characteristic of oil and water which will readily pick up odors from accumulated volatiles. In this test, two Petri dishes, one containing odorless mineral oil and the other distilled water, are placed in a larger container. Strips of the package samples are placed around the Petri dishes in the container, out of contact with the liquids. The container is covered and allowed to stand for 12 to 24 hr. After this period, the oil and water are sniffed. The oil will have picked up any odorous materials that are soluble in oil, and the water, any that are soluble in water.

Usually, both oil and water-soluble contaminants are present in suspect packaging materials. Such odor notes as varnishy or painty are picked up by the oil, and musty and sour, by the water.

Butter and Chocolate Tests

Perhaps most sensitive of all the odor tests are those tests based on the delicate flavor balances of butter and chocolate. In the butter odor-sorption test, a "sandwich" is made up consisting of a pat of fresh butter between two samples of the suspect packaging material. The sandwich is placed in a dish (a glass refrigerator dish is appropriate), covered, and allowed to stand. A control is set up simultaneously consisting of a pat of the same butter placed in a separate covered container, without the test samples of packaging materials. After 24 to 48 hr., the test butter is tasted and compared with the control standard.

It is also possible to set up a test where the board is not in contact with the butter. Such a test is often used to check the odor of an outside carton in which individually packaged foods are shipped.

In the chocolate odor-sorption test, package samples and plain milk chocolate are placed, out of contact with one another, in a dish, covered, and allowed to stand. Simultaneously, a control is set up. After 24 to 48 hr. the chocolate is tasted, and the flavor changes noted.

It is of prime importance in all these tests that the materials used, both media and containers, be immaculately clean, virtually odor-free, and, in the case of food test media, extremely fresh. When these requirements are met, the tests are strongly reliable indicators of the kinds of odors present in the packaging materials and the degree to which they are capable of contaminating.

Not every packaging-material sample needs to be put through the entire series of tests. For example if an objectionable odor is found to be present in the free-smelling test, which is the least sensitive test in the series, there is no point in continuing the testing on through the more sensitive tests; they will only emphasize that which is already evident.

In judging whether or not a packaging material is suitable or unsuitable for food packaging on the basis of the test results, one must consider not only the kind of odor but also its intensity. Occasionally, the kind of food to be packaged in the material may also be weighed in the balance.

GENERAL TRENDS NOTED IN PACKAGE-ODOR RESEARCH DATA

Besides the techniques, a vast body of information is slowly being built from the innumerable instances of odor problems in packaging and their solutions. As this body of information grows, it takes form and reveals significant trends and directions.

In the last several years the staff of the flavor laboratory has analyzed many samples of paper used in packaging. The data have been reviewed on 200 complaint samples of food packaging materials of all types produced by 20 or 30 different companies. Well over 50% of these samples represented justifiable complaints, in that they contaminated test media to a degree considered objectionable in terms of the average consumer. The nature and distribution of the odor notes present in these 200 actual complaint cases, considered in terms of their sources and causes, are very indicative of the danger spots in package production. Approximately 5% of the undesirable odors were traceable to adhesives and coatings; 10% to added odorants; 25% to printing inks; and 60% to board stock.

Odors Traced to Adhesives

Of the odors attributed to adhesives, an animal note was mentioned most frequently. This odor can be traced to bacterial or mold spoilage in the adhesive, caused by too infrequent cleaning of containers. Also caused by microorganism spoilage were sour (spoiled protein) and sulphide (eggy) notes. Other notes found in adhesives were diphenyl, due to contamination, and resinous, due to the resin base of the adhesive.

Odors Traced to Coatings

Most odors attributed to coatings were caused by the misuse of wax coatings. The most frequently mentioned note in

these was waxy. Other undesirable notes were oily and rancid.

There is certainly nothing wrong with using a wax coating for packaging materials, but, if such a coating is to be used, it must be used correctly. Wax, if left hot over a long period of time, oxidizes and develops unpleasant odors. Pro-oxidants such as copper and other contaminating metals, which speed up or catalyze the deteriorating influence of oxygen, also can cause odor problems in waxes. Antioxidants added to prevent this can themselves become sources of odors. Better handling of wax baths could eliminate the risk altogether.

Odors Traced to Added Odorants

Some of the odors attributed to added odorants were: floral (especially vanillin), woody (especially pine-oily), and fruity (especially grapy).

Odorants added to a package deliberately, either to enhance the merchandise or to cover up some undesired odor, can cause trouble when they are not added skilfully. Their successful use depends upon: the appropriateness of the odorant to the product, the stability of the odorant as a chemical additive, and the stability of the odorous materials already in the packaging material. Because added odorants can change over a period of time and can react with odorants already in the packaging materials, a desirable initial effect may become a revolting permanent one. Even if the added odorant does achieve the effect of masking undesirable odors by blending them, the newly created pleasing odor may still be a problem when and if it transfers to the food to be contained in the package. Therefore, although perfumes may occasionally solve odor problems in packaging, they should be used with caution.

Odors Traced to Printing Inks

In the odors attributed to printing inks, oily, buttery, and fatty notes were often mentioned. Such odors are caused by odorous oils, drying agents, and varnish bases. Varnishy or painty notes, traced to the same causes, brought up a close second in the running. Inky notes, third in frequency of occurrence, are blamed on odorous oils, driers, and pigments. Rancid notes, which occurred just as often as inky notes, are due to odorous oils and drying agents. Garbagy and chalky notes, occasionally found in inks, are blamed on off-odor oils and drying agents, respectively.

It is clear from this that the odors present in printing inks are inherent in the ingredients of the inks themselves. It is the responsibility of the printer to assure that inks to be used for food packages dry to a low odor-level. In cases where the desired artistic effect cannot be achieved without necessitating odorous inks, the effect should be modified. There is nothing aesthetically pleasing about a varnish-flavored cookie.

Odors Traced to Board Stock

Of the odors attributed to board stock, mustiness was mentioned more than any other odor note. A musty or moldy odor can usually be traced to the development of slime or the use of poor water in the system. It is occasionally due to careless storage of pulp.

Following mustiness in order of frequency of occurrence were the medicinal odors, including chlorophenolic, phenolic, and halogenlike odors. Here the viscious circle begins, for medicinal odors are usually the result of the misuse of the slime inhibiting agents introduced into the system to eliminate board-stock odor problem number one: mustiness.

Mentioned just as often as the medicinal odors was a papery or cardboardy quality. As you know, such odors are natural to stock and are only troublesome when too intense.

Odor problem number four in the board-stock odors proved to be kraft and/or burnt notes. These can often be associated with insufficient washing, and also with dirty water or low-grade materials.

Other odor notes attributed to the board stock were to one or several of the following causes: dirty, pulp, s or rinse water; insufficient washing; slime; misuse o inhibitors; contamination; or too much of odors nat the basic paper stock.

Sixty per cent of the odors found in complaint sam food packaging materials were traced to board stock estimate that over one half (55%) of odors due to stock are traceable to slime in the system, poor wa insufficient washing. One fifth (20%) can be blamed misuse of agents introduced to cut the mold and slime fifth (20%) can be traced to natural odors that are jus too strong. One twentieth (5%) are caused by dirt or contamination (*8*).

CONCLUSION

The pulp and paper industries, have, on the whole, consistently good job of producing odor-free paper pr for food packaging, in spite of many handicaps and de for specialized packages. In terms of the large num paper products produced for food packaging, the num complaints is small indeed. However, because a majo food-package complaints have been traced back to th and paper industries, the need for every company these industries to take odor-control measures is emph Most complaints attributed to board stock are directed a odors caused in the plant system by: slime develo slime inhibiting agents, dirty water, or insufficient wa Constant checking is necessary if satisfactory control c factors is to be achieved.

It is advisable for every plant, whether large or sm place an odor chemist or other suitable person in cha odor control. If possible, this odor expert should be ai a panel of assistants on whom he can draw for help in c decisions. Such an odor expert would: (1) detect an tify odors in the materials, system, or product; (2) whether odors found are at a level that must be cors objectionable in terms of the future use of the produc determine the sources of the odors and eliminate their c To achieve these things, the odor expert must have a th knowledge of odor chemistry and wide experience industry. Above all, he needs the complete support management.

Every complaint against a paper-packaged food rep potentially great business losses for the food, paper packaging industries. By maintaining an odor-contr tem in his plant, the paper manufacturer eliminates the c of odor problems and does himself, and his industry, a while service.

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Q. Mr. Weidner pointed out that in their experience the natural aptitude for odor detection; they have trainec school graduates to be satisfactory odor chemists.

Q. Can mustiness in board develop as time goes on?
A. No, unless it gets moist. Other masking odors may be lost, which reveals the original mustiness, however.
Q. What is odor making component of slime?
A. We believe it is a product of actual growth of organism. Once the organism is killed, there is no further development of odor.
Q. What steps can reduce board odor?
A. First step is good plant cleanliness. Next is to check your printing inks and slime agents.
Q. Is it possible that spore formers in board survive drying and start up again, causing odor?
A. According to published material paper is sterile. Further contamination is, of course, possible.
Q. If paper is sterile off the machine, is such reinfection surface only?
A. Yes, usually.
Q. What are relative odor intensities of ink odors compared to board odors?
A. They are in general similar.
Q. Could you overcoat board to reduce odors?
A. No. Cut edges would leak. This is not a practical approach. It only would slow the rate.
Q. If a container were overcoated with wax, both sides, like paper milk bottles, would this reduce odors?
A. No, since many odors penetrate wax.
Q. Are most paper odors water soluble?
A. Most are, but not all.
Q. Would wood odor, sassafras, for example carry over?
A. Yes, but these are not usually objectionable.
Q. Can people smell samples for long periods without losing ability temporarily?
A. Yes. In certain cases it is not possible, vanilla for example. Also formaldehyde or ozone kill sense of smell.
Q. Can odors be removed, medicinal odors in particular?
A. A part per million or less can cause an odor. Sometimes exposure to air for long periods will help, or putting paper through a drying tunnel, however, you must know source of odor, and its characteristics.
Q. Are your complaints odors or tastes?
A. Usually tastes, because housewife tastes, then gets odor through nasal passages. Actually odor is what she notices.
Q. How do you judge the "objectionableness" of an odor?
A. Use a panel, and use butter or chocolate contamination. Consensus will give answer.

C. R. CALKINS, *Secretary*

Pacific

Pacific Section TAPPI met March 19, 1954, in West Linn High School at 2:00 p.m. Fred Weleber, Pacific Section chairman, presided at this meeting, and Glen King handled the local arrangements and served as moderator for the afternoon technical meeting. There were 154 in attendance.

This was our annual Shibley Award meeting and the following four papers were presented:

"Methods and Results of a Kraft Mill Sodium Balance," by Max Custis, Crown Zellerbach Corp., Camas, Wash.

A sodium balance at the Camas kraft mill accounted for over 98% of the total sodium lost from the system. Out of an average daily loss of 104.0 lb. Na_2SO_4 per ton of air-dry pulp as determined by salt cake usage and inventory data, the three major sources of loss were identified as follows: main sewer 30.5 lb. Na_2SO_4 per ton pulp, furnace stack gases 22.8 lb. Na_2SO_4 per ton pulp, and pulp soda losses 48.8 lb. Na_2SO_4 per ton pulp.

Investigation of the causes of high losses indicated the major factor was the operation of equipment above design capacity. It was found that close attention to operation details could alleviate this condition. Methods used in determining concentration of sodium and flow rates are described.

"Variables Affecting Brightness of Unbleached Sulphite," by David L. Mosher, Fibreboard Products, Inc., Port Angeles, Wash.

It was determined during this project that reducible sulphur is present in unbleached sulphite to some extent at all times. The percentage of reducible sulphur must be held below 0.01%

D. L. Mosher, Frank Dinger, Max Custis, and J. F. Farrington, Shibley Award contestants

in order to realize 58.0 or better brightness. Most of the reducible sulphur is formed during the cooking cycle.

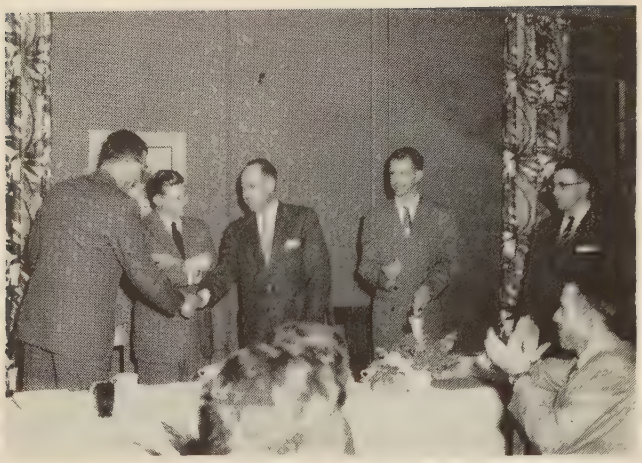
The percentage of lignin present in the unbleached sulphite was correlated to the brightness. Percentage lignin also follows the permanganate number, the hard uncooked pulp having the highest percentage of lignin. In general, hard unbleached sulphite is dark.

Temperature was found to be the controlling factor throughout this project. Ample time must be allowed for complete penetration of the cooking liquor. A slow uniform temperature rise was proved to give the best results.

"Possible Improvements in the Routine Analysis of Ordnance Pulp," by James F. Farrington, Scott Paper Co., Everett, Wash.

In the use of conventional analytical methods for the rou-

Glen King, moderator for the Shibley Award meeting, and Fred Weleber, Pacific Section chairman



J. L. McCarthy presenting the Shibley Award to Frank Dinger

Group scene at the dinner during the Shibley meeting

tine testing of alpha, beta, and gamma-cellulose in ordnance pulp, the agreement between results on duplicator samples was sufficiently variable to necessitate repeat determinations rather frequently. This situation increased the testing time required and restricted the degree to which these values could be used for the control of pulp quality.

Therefore, a study for possible improvements in the routine analysis of ordnance pulp was initiated. This study included many of the physical and chemical variables which might influence the results. Particular emphasis was placed on various filtering media for a more effective separation of the alpha and beta-cellulose fractions.

The results of this investigation show that reproducible and accurate results may be obtained by using a modified procedure which is described in the paper. The modifications appear interesting as possible improvements on the conventional method for routine control testing.

"The '80-Grit-Touch-Up' Method for Maintaining Calibration of the Valley Laboratory Beater," by Frank Dinger, Puget Sound Pulp & Timber Co., Bellingham, Wash.

Maintenance of a laboratory beater in uniform calibration is one of the principal problems encountered when evaluating pulp quality by beater results. The investigations described were initiated in an effort to find a reproducible rapid method of maintaining calibration which would overcome difficulties experienced with existing published methods.

Variables common to all methods for calibrating the valley laboratory beater were studied. The bar surface roughness was found to have no effect upon strength development. The roll-bar's leading edge must be shaped with sufficient r result in a minimum of fiber cutting. The turbulence in the roll section should be minimized by a properly bed plate and correctly shaped lead grout. The pressure between the beating surfaces was effective varying the beating rate.

It was further observed that very slight accumulat pitch on the beating surfaces seriously affected streng velopment. These pitch accumulations were found t uncontrollable factor in beater calibration. It was a served that grinding with 80-grit carborundum prod beating surface including a sufficiently dull leading e the beater bars to give the desired strength develo These two observations prompted the development "80-grit touch-up method" which is described in This method has been in use for 18 months, giving repro and dependable results with a minimum of maintena quired for uniform beater calibration.

At 5:30 p.m. the group moved to the West Linn Hi a social hour, followed by dinner at 6:30. After din McCarthy presented each of the contestants with a graphed textbook of Sutermeister's textbook and the Frank Dinger, with a $50 check.

William A. Ditmer, power manager for Kaiser Alumi Chemical Corp., gave a very interesting talk on the re ship of hydroelectric power and the manufacture of alu and pulp and paper.

The next meeting will be held May 20, 21, 22 in conju with the Superintendents' Association at Gearheart, O

H. B. Petersen, *Secretary-Trea*

R. I. Thieme reporting on the National TAPPI meeting

W. A. Ditmer addressing the Pacific Section gr

Chicago

Development of the Chem-Dry process for drying ink and coating on paperboard, paper, and other materials was outlined at the March meeting of the Chicago Section of the Technical Association of the Pulp and Paper Industry by Herbert L. Barnebey, chemical engineer of Pittsburgh, Pa. He was assisted by John D. Keane, research chemical engineer, Armour Research Foundation, Illinois Institute of Technology, Chicago. Mr. Barnebey first made clear that the Chem-Dry process had been developed by the Armour Research Foundation. As yet, no commercial installations have been made, but a pilot plant is in operation at the Foundation, where some successful results have been obtained. The research work was instigated by the Meyercord Co., Chicago, Ill., who were interested in a method of drying decals upon which 10 to 12 colors were applied and where inks had to dry overnight between each color application.

The Chem-Dry process consists of the application of sulphur dichloride to the material to be dried, whether it be ink or coating, and its reaction with the vehicle to promote rapid drying. In ordinary nonsolvent printing inks, having an oil base, the sulphur dichloride vapors penetrate through the coating before hardening. A thick coating of ink can be hardened within a few seconds to the point that it does not offset, although complete drying takes place after the material comes out of the treating chamber. It takes 1 or 2 hr. for a 2-mil coating of varnish to dry. Alkyd resins work well with the sulphur dichloride as do some types of rubber. With urea and melamine resins, an acid catalyst is used to initiate polymerization. Paper may be affected by formation of hydrochloric acid when excess moisture is present but this can be avoided by minimizing the contact time or by neutralizing with ammonia gas. In summing up, Mr. Barnebey cited the following advantages of the system: (1) the coating will harden in a few seconds, (2) complete surface drying eliminates offset, (3) no bleed in varnishes, (4) no heat or solvents required, (5) cured coatings give better protection than other coating methods, (6) porous materials do not soak into the stock to any great extent, (7) speeds the operation if the coatings are to be applied one over the other, (8) cost is lower than other methods now in use.

However, there are also some disadvantages and the speaker cited the following: (1) a modification of most coating formulas is necessary to utilize the Chem-Dry process; (2) it does not work well with lacquers or with coatings using solvents; (3) special equipment is needed; (4) some applications need further development work; (5) sulphur dichloride fumes have a penetrating odor and must be confined to the machine; they do not remain as residual odors in the coatings after drying.

J. R. Lyons, The F. C. Finley Co.; J. J. McIntyre, H. B. Fuller Co.; H. L. Barnebey, E. C. Berg, Ace Carton Co.; J. D. Keane, Armour Research Foundation and K. Harita

Kalamazoo Valley

The Kalamazoo Valley Section of TAPPI met at the Hotel Harris, Kalamazoo, Mich., April 1, 1954, with an attendance of approximately 90. R. H. Hurst, chairman, presided.

Mr. Hurst called the attention of the membership to the death of member R. E. Burkhardt, St. Regis Paper Co. Mr. Burkhardt was an outstanding participant in the affairs of the Kalamazoo Valley Section of TAPPI and his loss will be sorely felt.

Mr. Hurst announced that the next meeting of the Section will be Thursday, May 6, at which time the seniors of Western Michigan College School of Paper Technology will present their senior theses.

Mr. Hurst turned the meeting over to J. A. Dean, vice-chairman, who introduced George H. Pringle, TAPPI President, who covered some interesting aspects of National TAPPI organization, operation and growth, and presented a provocative talk on "Human Engineering in the Pulp and Paper Industry." A summary of Mr. Pringle's talk follows:

George Pringle, President of TAPPI, addressing the Kalamazoo Valley meeting

"In addition to the necessity of increasing enrollment of technical men in universities and also encouraging their participation in the paper industry, it is necessary to utilize their talents and the talents of all employees to the utmost through what might be termed human engineering.

"In the past the paper industry has developed many new tools to improve quality and lower cost, but very seldom has any thought been given to the effect of accompanying charges on the employee. Fortunately, this situation is now being remedied although much is still to be desired."

Mr. Pringle summarized several specific methods which could be used to implement the "human engineering." Some of the suggestions follow:

1. In the initial planning of any new project we should take into our confidence the operators and should fully consider their ideas on equipment as well as process.

2. As the project progresses, the employees should be kept well informed of the proposed changes, particularly those which could affect their job. Any relocation of employees necessitated by the changes should be thoroughly planned and discussed with the employees at least several months before the changes are made.

3. Take necessary steps to obtain in writing the "know-how" of experienced old-time papermakers. This information is indispensable for the training of younger men. This may be accomplished by assigning a good tour foreman to work with the men and record their methods for operating in various situations.

4. Communications both up and down the line of organization must be excellent and well organized. Various "levels" of meetings should be held routinely to serve both directions of information flow. The use of regular (even daily) publications and bulletin board items will be helpful. Timely "pats on the back" are extremely helpful.

Time spent in "human engineering" will return many benefits including the wholehearted participation of all

J. A. Dean, Michigan Paper Co.; W. F. Hathaway, Kalamazoo Vegetable Parchment Co.; G. H. Pringle, Mead Corp.; R. H. Hurst, Kalamazoo Vegetable Parchment Co.; and R. T. Trelfa, Watervliet Paper Co.

employees in the solution of problems important to the mill, active interest in mill progress, and the knowledge that each is important to the over-all success of his company.

R. T. Trelfa, *Secretary*

Empire State

The following paper was presented at the annual meeting of the Empire State Section, which was held at the Whiteface Inn, Lake Placid, N. Y., on June 9, 1953. Publication was delayed pending receipt of copy.

"Air Removal" from Paper Machine Stock

Geoffrey D. Hughson

All forward-looking companies in the pulp and paper field are today searching for improved, product quality so that competitive positions could be maintained in a buyers' market. It is sometimes difficult to keep future quality in mind while engaged in the present very necessary struggle toward reduction of manufacturing costs, but the importance of doing so cannot be denied.

As a part of its long term planning, Canadian International Paper Co. has for some years been studying the flow characteristics of various stocks with a view to improving machine performance and paper quality. Very early in this work, it was concluded that fiber flocculation was largely governed by the mechanical conditions of flow. Of these mechanical conditions, the air and other gas present as a third phase were considered to be a major contributor to flocculation.

The presence in headbox stock of gas in the form of large bubbles has long been a papermakers' problem for, while it readily leaves a slow-moving stock by rising to the surface and breaking there, its movement encourages flocculation and even creates turbulence. There is another form in which this third phase occurs—as minute bubbles which are largely adsorbed on fibers or other particles. These very small bubbles are tenacious and become more so in inverse proportion to their size; for practical purposes they have become a part of the fibers, contributing to their movement and their entanglement. Such bubbles will also cling to headbox surfaces, carrying and holding fibers and pitch, and will be responsibile for much of the accumulations found there. now known that the complete removal of the gaseous from paper and other stocks results in striking chan flow characteristics—changes which, among other be allow radically different approaches to headbox design

At the time of our original interest in the subject of moval, it was realized that there were certain other tages to be gained, the more obvious being: (1) elimi of headbox foam, rendering unnecessary the use of he showers or chemical defoamers; (2) reduction of the ten of the stock to form the lumps which often cause w breaks; and (3) reduction of fouling of perforated plat flow eveners.

J. A. DeCew of Mount Vernon, N. Y., was the ho the original patents covering removal of air-in-stock method of spraying into an evacuated space; howeve was known at that time of the practical application ideas -particularly with regard to the degree of vacuu spray dispersion required for complete removal of gas firm of pulp and paper engineers, Clark and Vicario c York, obtained full rights to the use of the original pr and, by applying their wide experience in the paper general and vacuum equipment in particular, proce develop it for mill use.

With the wisdom born of hindsight, we all now reg unfortunate the installation of the very first model de on an operating machine. However, it did point up conveniences of attempting to experiment with equi design and to make paper at the same time.

It was at this stage that Canadian International b interested in the development from the standpoint c flow. A most satisfactory agreement was reached, enabled each party to benefit by the experience of the and which entailed no future obligations on eithe Accordingly, this first CVCO deaerator (of about g.p.m. capacity) was installed in the pilot plant of Ca International Paper Co.'s research and development ment in conjunction with an experimental pressu headbox of new design. As a brief description, the de was a vertical cylindrical tank, about 4 ft. in heigh single 3-in. spray nozzles were set in the bulged top, ft. diameter flat impingement plate was located in th about 2 ft. below the nozzle orifices. A single outlet tank top led to a small two-stage vacuum system co of a steam jet ejector with condenser, and a Nash v pump for removal of noncondensable gases. The sto the nozzles as a fine conical spray; in this form it cc longer entrain the larger gas bubbles, and these were removed by the existing vacuum. As was proved riods of operation without the impingement plate, hc the fibers to which the tiny bubbles adhered needed th tional shock of striking the plate before they would su the remaining gas.

Based upon results of pilot plant operation, dea equipment was designed for one of the 160-in. ne machines at Three Rivers, Que. Its capacity wa g.p.m. of headbox furnish at 0.6% consistency.

Following the successful performance of this insta further work was done to find out just how much eva volume was required for each gallon per minute of s stock. As a result, it was found that drastic space eco could be safely made, and these economies led to th Deculator design. A baffle runs from end to end of t diameter horizontal tank, and extends from the roof ve downward almost to the tank center-line. A row g.p.m. nozzles is located on either side; each nozzle h orifices such that the stock is sprayed partly against th less vertical baffle and partly against the stainless-clad wall of the tank itself. The interior of the tank, exc nozzles and spray impingement areas, is lithcoted.

In order to build the improved-design equipment

Geoffrey D. Hughson, Chief Chemist, Newsprint Research & Development Dept., Canadian International Paper Co., Gatineau, Que.

work toward further improvements, the Rotareaed Corp. of Bronxville, N. Y., and a sister-company, Rotareaed of Canada, Ltd., were set up. These companies now handle all design, engineering, and development work on the process.

A typical location, when installed in conjunction with a paper machine, would be between the Bird screens and the headbox. A primary fan pump mixes the white water and the machine stock and discharges it through a control valve to the screens. All of the accepted stock from the screens flows into a trough whose level is automatically controlled by this valve. From the trough, the stock is drawn into the two distributor headers which feed the two rows of nozzles inside the receiver tank.

The gases from the tank are withdrawn by a number of outlets at the top into a vacuum header and thence to a pre-condenser with water sprays which knock down the more-readily-condensable vapors. The gases remaining are drawn out by a steam-jet ejector which discharges to a second water-spray condenser. Noncondensable gases, including the air, are removed from the latter condenser by vacuum pumps, usually two units in series.

By means of the vacuum system described, the absolute pressure in the Deculator receiver tank is maintained within 0.3 in. mercury of the boiling pressure corresponding to the existing stock temperature; this very low pressure has been found necessary in most cases for removal of the tenacious small bubbles previously mentioned.

The lower half of the receiver constitutes a reservoir whose level is controlled to within an inch by an automatic valve or valves on the spray nozzle supply. A float cage at one end of the tank houses the level-measuring element. This control is made necessary by the need for a constant suction head on the secondary fan pump which is usually located immediately below the Deculator tank and which feeds the machine headbox. This pump must be carefully specified and its shaft well sealed with water, and its supply line from the Deculator must be perfectly vacuum-tight, since the pump suction will be at about 15 in. vacuum and inward air leaks must be prevented.

The instrumentation consists of Deculator pressure and stock temperature recorders as well as the recorder controllers on the screen discharge trough level and the receiver tank level. It has been Rotareaed Corp.'s custom to mount all the related instruments, control valve position signals, and switches on a panel in some convenient wet-end location.

Condenser spray water and vacuum pump seal water rates are adjusted by the suppliers before initial start-up and should need alteration only in the event of a real change in mill supply pressures; a small independent booster pump will sometimes be an advantage.

Considerable progress has since been made toward reducing equipment size as well as lowering installation and maintenance costs. Newer Deculator receiver tanks and piping are entirely stainless steel, and all joints and seams are welded. Control of stock supply to the most modern Deculators is achieved by means of a butterfly valve through which all of the stock passes; previously, on a 20-nozzle receiver, the flow to three nozzles might be controlled automatically, while eight had manual valves and the remainder were fitted with figure 8 blanks.

Further reductions in receiver size have been achieved; it would now be possible to replace Canadian International Paper Co.'s first 20-ft.-long Deaerator with an equally efficient 6-ft.-long Deculator of the latest design.

Much has been done to reduce the space requirements of auxiliary equipment as well—after exploration of the idea at the Gatineau pilot plant, Rotareaed has plans for elimination of condenser drop-legs and for the use of white water or stock rather than fresh water in the condenser cooling sprays.

Pre-ejector condensers have been eliminated, and the steam ejector and the condenser are now integral parts of the Deculator receiver assembly, with all the condensed steam and stock returning from the condenser to the receiver through a spray nozzle. Besides conserving space, these changes result in recovery of the heat from the ejector steam, giving increased stock temperature going to the headbox; on some machines where steam is normally added to the wire pit for this purpose, the extra steam would no longer be necessary. On some kraft machines, where extremely large quantities of steam are added to the wire pit, it is possible to eliminate use of vacuum pumps; this is achieved by means of two stages of steam ejectors—the first stage discharging to a stock-spray condenser from which the liquid returns to the receiver tank, and the second stage discharging to the wire pit.

For kraft board machines having both primary and secondary headboxes to which are fed two different furnishes, a duplex design has been built. One receiver tank is partitioned to accommodate the separate furnishes, and a common vacuum system is used. Separate fan pumps and control systems are employed, but otherwise the process is basically the same as that already described.

Development work is also in progress on an application of the Decualtor to paper coating color.

It is naturally of interest to know what improvements are claimed by the suppliers for their process and whether these claims are borne out in practice. Mills across the country vary tremendously in the amount of foam in the headbox and at other points in the system, and also in the degree of foam stability. Other features of machine operation which are affected by air-in-stock may or may not be considered important, depending on the mill and the personnel involved. We of Canadian International Paper Co. believe, however, that by complete elimination of the third phase new fields of headbox design can be entered. Apart from this particular interest, the more general improvement claims should be considered:

1. Absence of foam and other forms of gas in the headbox and on the wire, with elimination of the need for headbox showers and chemical antifoam agents.
2. Reduction of slime breaks and lump breaks giving a safer-handling sheet and increases in machine efficiency and tonnage.
3. Increased drainage on the wire, allowing reduction of headbox consistency to give better formation; hence a higher couch vacuum and a drier sheet off the couch.
4. Reduction in sheet porosity.
5. Increases in wire and felt side smoothness.
6. Possible reduction in percentage of sulphite in furnishes where it is added for wet strength, or possible increased speeds with the same amount of sulphite.

Some or all of these claims have been justified by each installation. At the present time, there are nineteen units operating in the United States and Canada. By grades, these are distributed as follows: 8 on newsprint; 3 on 9-pt. semichemical corrugating board; 1 on wastepaper corrugating board; 1 on book, bond, and waxing; 1 on bleached kraft food boards; 2 on kraft bag papers; 1 on photographic papers; 1 on kraft liner board; and 1 on various grades in a pilot plant.

Further installations are being made on 9-pt. corrugating, groundwood, and sulphite catalog papers, wallboard, kraft liner board, glassine and greaseproof, and newsprint.

On various newsprint installations, efficiency increases have ranged as high as 6%, porosity has dropped by 20 to 50%, and smoothness has climbed by some 10 to 20%. The greatest machine speed increase due solely to deaeration has been 150 f.p.m.

In addition, Rotareaed have supplied the following information:

"Three machines making 9-pt. corrugating have been speeded up by 50, 70, and 140 f.p.m.; this is almost certainly due to the fact that a dryer, safer-handling, and easier-to-dry sheet is leaving the couch. Residual chemicals from the pulping process are no longer maintaining any of the heavy

blanket of foam which formerly covered the headboxes, and antifoams are no longer in use. Crush test has improved on the product.

"The wastepaper corrugating board installation has resulted in the following improvements: single flute test 18 to 20% higher, ring-type crush test 5% higher, and finished production about 3 to 5% higher.

"As established by comprehensive study of two 6-month periods, one before and one after the installation, a kraft paper machine Deculator has saved a little more than 3 hr. per mo. of down time due to wet-end breaks, and 5.9 hr. per mo. due to dry-end breaks; machine efficiency was up by 3%, and drying steam consumption was down by 17%. Product quality improvements were also confirmed by this study.

"On bleached kraft food board, particularly on coffee cup stock which is heavily loaded with rosin size, alum, and wax, machine speeds and general ease of operation are at a level which is apparently impossible to reach without deaeration.

"A machine on kraft liner board is making an average of 23 tons more production with the same number of driers and the same back pressure. Chemicals were normally added for strength improvement on this machine—the amount of additive has now been cut, at a saving of from 75 cents to a dollar per ton, and bursting strength is still about 8 points above the pre-deaeration level. Smoothness is also higher."

It is obvious that many of the installations have been tremendously successful. In spite of this success, the suppliers of the equipment have never shown excess enthusiasm by claiming the Deculator to be the universal answer to wet-end problems. A prospective user should naturally consider the amount of air already in his stock and the possible benefits to be gained by its removal. In this respect, the ever-growing variety of applications on this continent can be very helpful. Against the benefits must be balanced the cost of the equipment.

It is impossible to generalize by saying that a certain furnish or grade or a certain type of machine requires removal of air, or that air removal would be very helpful in every case. The only positive statement which is allowable is that the possible benefits of deaeration should be given study by every quality and cost-conscious mill.

Empire State (Western District)

The following paper was presented by Mr. Sheldon at the February meeting of the Western District of the Empire State Section, which was held at the Prospect House, Niagara Falls, N. Y., Feb. 3, 1954.

High Density Superbleaching of Chemical Pulps

F. R. Sheldon and I. C. MacGugan

For purposes of the following discussion, superbleaching is defined as the raising of brightness above the point normally encountered in any given bleaching instance. In other words, if normal pulp production generally reaches the 80 brightness level, we will consider any treatment which gains additional points to be a superbleaching treatment.

Except for purposes of contrast, the treatments herein discussed will be those employing hydrogen peroxide, and, by virtue of their increased efficiency, only peroxide bleaches at densities of 25% and over will be considered.

As the above definitions have indicated, we will be dealing with final stage peroxide treatments following purification and semibleaching with less expensive chlorine agents. We

F. R. Sheldon and I. C. MacGugan, Pulp and Paper Research and Development, Buffalo Electro-Chemical Co., Inc., Div. of Food Machinery and Chemical Corp., Buffalo, N. Y.

E. P. Feigenbaum, Moore Business Forms, Inc., and Sheldon, Buffalo Electro-Chemical Co.

feel that the greatest return per chemical dollar is ac with hydrogen peroxide in such sequences, and will en to show peroxide's role in obtaining brightness increa the higher levels without fiber damage but with im brightness permanence.

PEROXIDE PROCESSES FOR SUPERBLEACH

There are, in general, three types of high density pe processes which may be used for superbleaching:

1. The first, *last stage tower bleaching*, is carried out final stage in the bleach plant, *per se*. The increased re

Table I. High Density Last Stage Tower Ble Results

Pulp	Preliminary stages	Temp., °C.	Time, hr.	H_2O_2 (50%), %	Brigh Original
Southern pine kraft	3	52	3	0.40	72.(
	3	52	3–5	0.20	78.5
	5	52	3	0.50	80.5
Sulphite	1	55	1	0.50	65.0
	1	60	2	1.00	65.0
Neutral sulphite semichemical	3	52	3–5	0.50	80.7
	3	52	4	0.50	80.2

[a] G.E. or equivalent.

rate of high density operation produces optimum res terms of increased brightness gains, shorter bleaching greater production capacity, and reduced temperatur corresponding steam savings. Washed pulp from a pr bleaching stage is thickened to as high a density as po thoroughly mixed with alkaline hydrogen peroxide, to 50 or 55°C. or as high as permitted in the existing ment, and retained as long as possible. After retentio

Table II. Steep Bleaching Results

Pulp	Preliminary stages	Time, days	H_2O_2 (50%), %	Brigh Original
Soda	2	2–7	0.20	80.8
Northern kraft	3	14–21	0.50	81.0
Western kraft	4	5	0.25	81.8
Jackpine kraft	6	9–14	0.50	81.5
Sulphite	3	20	0.25	80.4
			0.50	83.5
Neutral sulphite semichemical	3	12	0.50	86.2
Rag	3	4	0.25	80.8

[a] G.E. or equivalent.

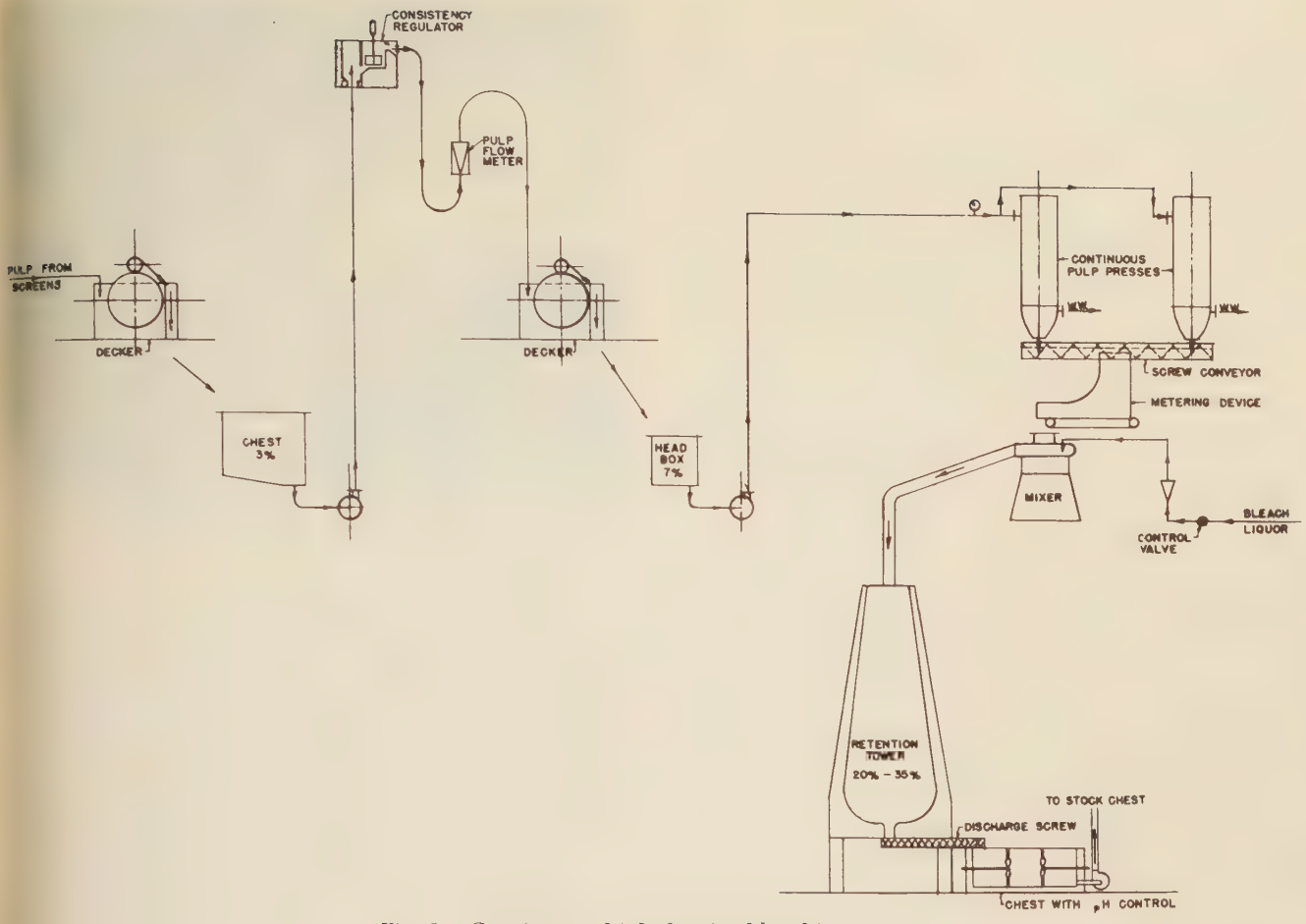


Fig. 1. Continuous high density bleaching system

pulp should preferably be washed prior to neutralization and use (Fig. 1).

The second superbleaching method is *steep bleaching*, wherein partially bleached pulp is dewatered to high density, the peroxide chemicals applied to or mixed with the pulp, and finally the high density pulp allowed to steep in the moist

Table III. H_2O_2 for Cold Steep Bleaching of Kraft Pulps

H_2O_2 (50%), %	Brightness, G.E.	Viscosity, cp.
0.25	74.5–84.5	
0.50	74.5–86	
0.75	74.5–87	27–26
1.0	70 –85	13–15
2.0	70 –87.5	13–12

condition for 1 day to several weeks, as desired. Initial dewatering prior to peroxide application can be effected by feltless wet machines (such as Kamyr and IMPCO and, in some cases, Rogers machines) or by screw-type presses. For efficient application of chemicals, refiner-type mixers may be used on pulp crumbs, while roll or spray applicators are used on continuous pulp sheets prior to cutting and slitting. In the latter case, varying amounts of bleach liquor may be applied depending upon whether the pulp is to be stored or shipped (Figs. 2, 3, and 4). If impregnated pulp is allowed to freeze, bleaching action is suspended until the pulp is thawed.

Sheeted pulp to be stored may often be saturated adequately by means of a simple padder-type (roll) applicator with distribution pipes. Pulp to be shipped, on the other hand, requires the addition of a minimum of bleach liquor in order to achieve lowest freight increments. Thus, spray application of small amounts of bleach liquor with even distribution is desired. Using the newer type flat spray nozzles with tapering solution delivery on the fan edges, a spray manifold with an overlapping pattern may be designed which will give excellent lateral solution distribution across the web width. With sprays, total bleach liquor pickup on the dry pulp basis can be as low as 5 to 15%.

These lower pickup percentages are possible when a "split application system" is used. This system consists essentially of applying the alkaline portions of the bleach liquor to the sheet ahead of the last press whereby they are

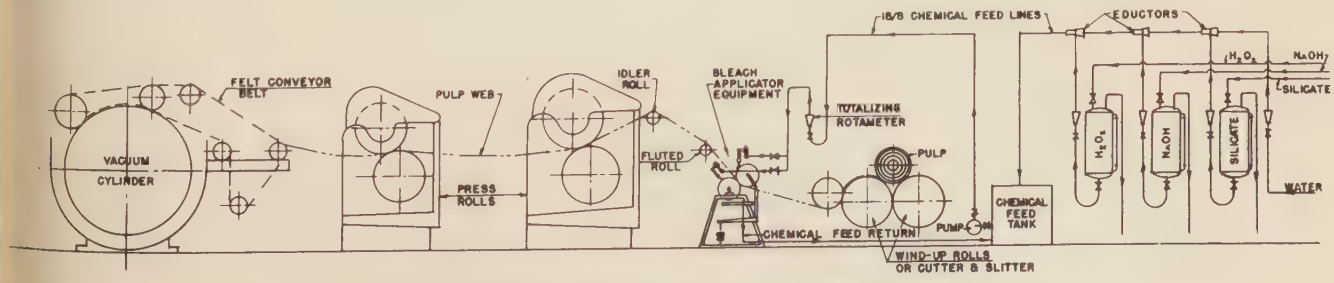


Fig. 2. Steep bleaching of continuous pulp webs

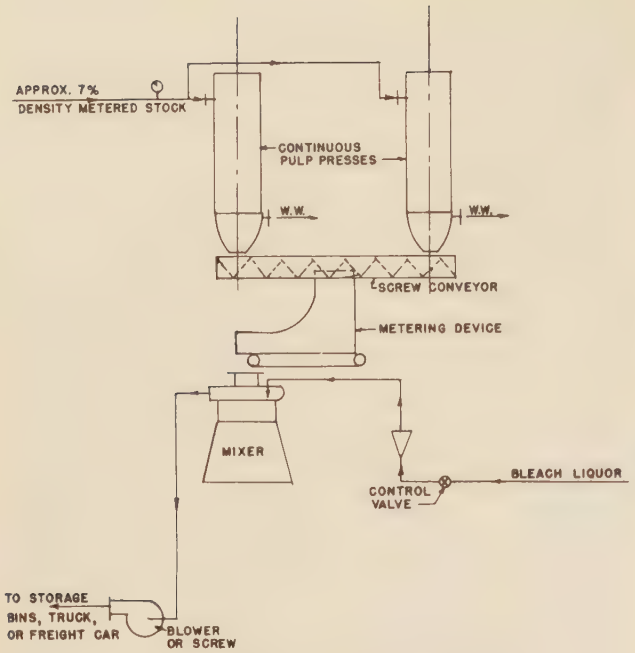


Fig. 3. Steep bleaching of pulp crumbs

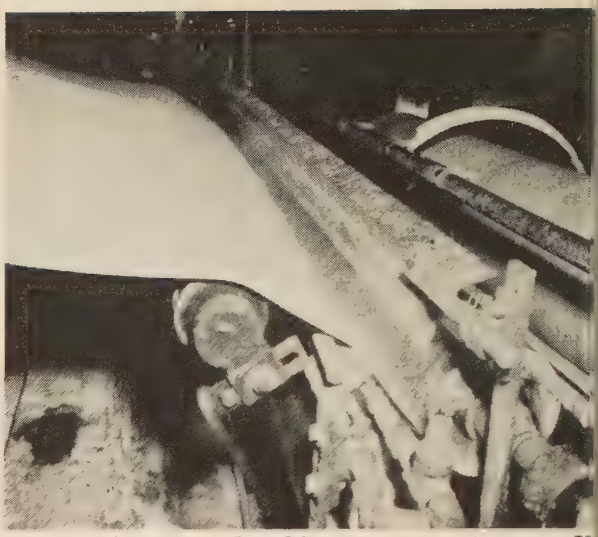


Fig. 4. Commercial cold steep operation on K machine

squeezed into and throughout the sheet. A small amount of diluted hydrogen peroxide is then applied by itself after the press to the then alkaline sheet (Fig. 5). The Becco research and development group is currently studying recovery systems for the alkalies (generally silicate of soda and caustic soda) and are determining cost break-even points between per cent recovery and average freight charges.

The third and final process, *pulp drier steep bleaching*, consists of applying peroxide chemicals to a formed sheet on a pulp machine as the pulp leaves the last wet end presses before entering the drier section (Fig. 6). Pulp sheet producing equipment can be a fourdrinier, cylinder, or feltless (Kamyr) wet end followed by a Flakt, Ross, or steam-heated cylinder drier. While the major fraction of the brightness gained by this treatment occurs during passage through the drier, some of the applied hydrogen peroxide remains i pulp off the dry end and is present during bale stora shipment for a variable time depending on pulp purity Drier steeping permits high quality pulp at higher normal brightness levels, at reasonable costs, and wit proved brightness stability during shipment or storage intermediate costs, the process may also be used to tain bleach plant brightness at the dry end of the pul ducing equipment. Since the process is essentially eith or off, depending on whether or not bleach liquor is the sheet, it eliminates the problem of transition pulp other words, there need be no large quantity of pulp acc lated between changing from a normal brightness grad superbleached grade.

With drier steeping, particular attention must be pa the amount of added moisture, evenness of distrib pulp sheet basis weight, as well as to type of formula may be used. The "split application system" is wel for use with drier steeping, since it offers the possibil t

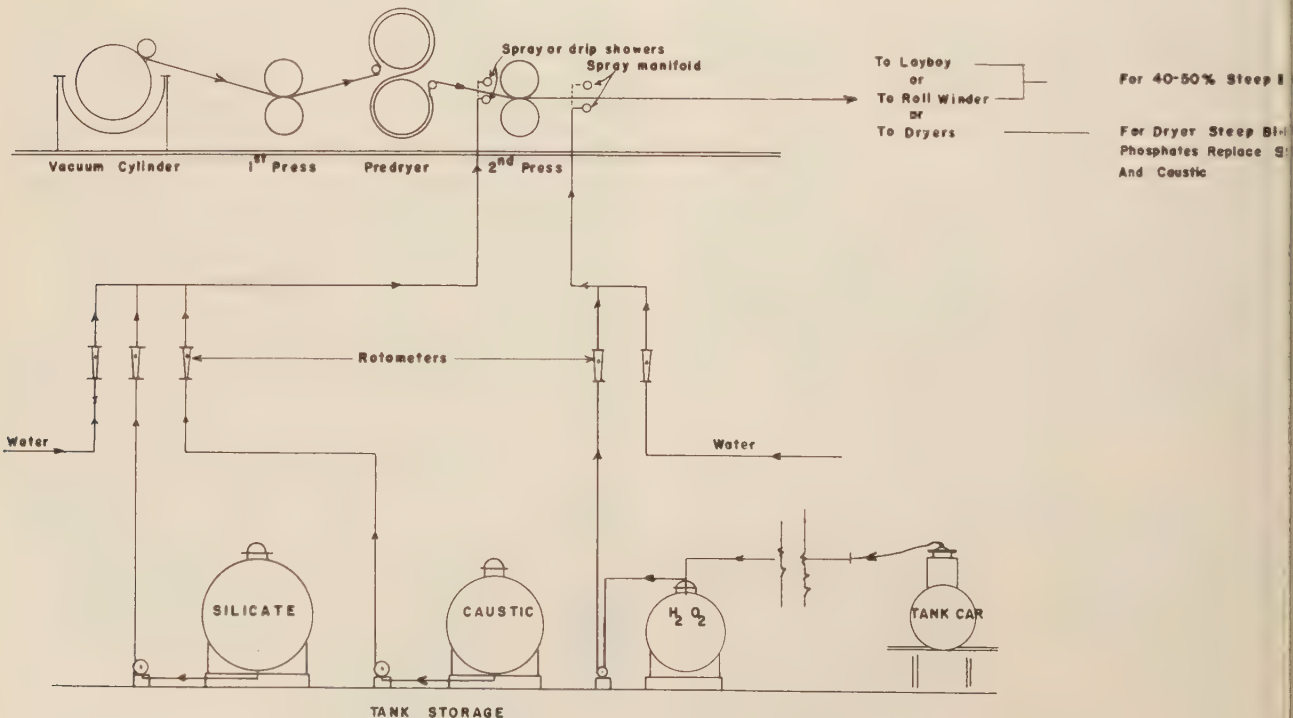


Fig. 5. Split application system for Becco steep bleaching process

Table IV. Drier Steep Bleaching Results

Pulp	Preliminary stages	H_2O_2 (50%), %	Brightnesses (G.E. or equivalent) — Off dryer — Normal	Off dryer — Treated	Aged — Days	Aged — Normal	Aged — Treated
Soda	1	0.50	79.9	82.2	5	79.4	83.1
	3	0.25	77.7	79.7	7	75.9	79.5
Sulphite	3	0.35	79.9	84.5	8	78.6	85.8
	3	0.25	86.1	86.7	7	86.0	88.7
Northern kraft	2	0.20	82.9	85.2	14	82.4	85.7
	5	0.40	83.4	85.2	56[a]	81.7	87.4
Southern pine kraft	5	0.60	81.3	86.1	30[a]	78.8	86.9
	$5 + ClO_2$	0.25	85.5	88.1	14[a]	86.2	90.0
	$5 + ClO_2$	0.50	87.5	90.6	7[a]	86.4	91.5

[a] Aging in bale under normal mill or shipping conditions.

minimum amount of added moisture; otherwise, a penalty ue to decreased machine capacity, increased steam usage, r increased freight is involved. Five per cent pickup is not reasonable using the split application technique. If a process may be applied to sheets weighing from 250 to 1100 lb. per 3000 sq. ft.

An interesting characteristic of this process is that alkali penetration is more difficult to achieve than is that of hydro-

Table V. Aging of High Viscosity H_2O_2 Bleached Pulp

Pulp	Type of H_2O_2 bleach[a]	H_2O_2 (50%), %	Brightness[b] — Original	Brightness[b] — Final	Aging conditions
oda	None	..	81.4	78.6	30 days at room temp.
	2	0.40	85.9	82.6	
ulphite	None	..	86.1	85.4	7 days at 60°C.
	3	0.25	86.7	87.7	
orthern pine kraft	None	..	79.3	75.0	28 days at room temp.
	2	0.35	82.5	80.5	
	None	..	82.1	81.6	5 days at 50°C.
	3	0.40	85.6	85.2	
outhern pine kraft	None	..	81.4	81.9	5 days at 50°C.
	3	0.40	83.5	85.4	
	None (hypo)	..	83.4	76.9	4 hr. at 100 ± 5°C.
	1	0.43	83.3	77.2	
eutral sulphite semichemical	None (hypo)	..	86.2	71.2	4 hr. at 100 ± 5°C.
	1	0.5	86.9	78.5	
	2	1.0	86.4	78.1	

[a] 1 = last stage tower bleaching; 2 = steep bleaching; 3 = drier steep bleaching.
[b] G.E. or equivalent.

gle solution, carrying both hydrogen peroxide and alkali, applied, pickup percentages will run between 10 to 15% h good economy. Within this range, higher sheet basis eights will require higher pickups. The drier steeping gen peroxide and consequently pH control of the incoming sheet is desirable in terms of dry end brightness and over-all brightness permanence. When used jointly with hydrogen peroxide, phosphates such as sodium tripolyphosphate and

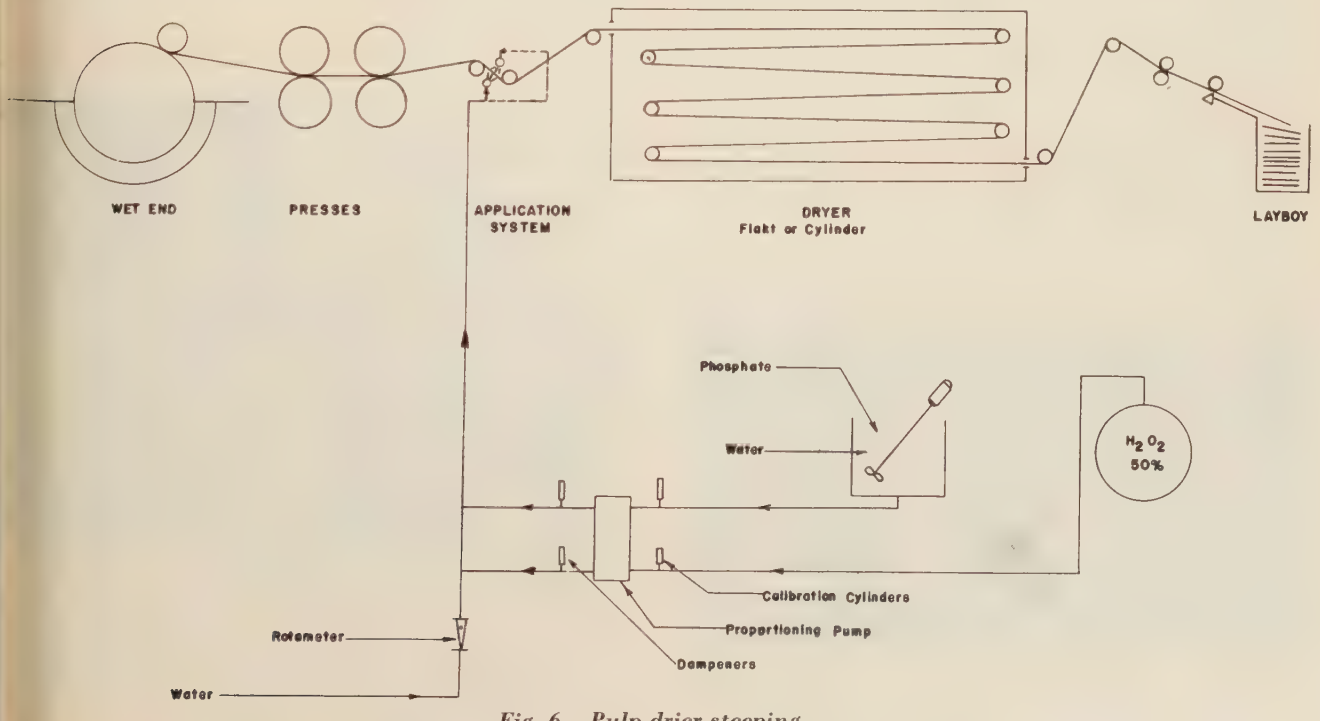


Fig. 6. Pulp drier steeping

tetrasodium pyrophosphate have been found to be particularly effective as the source of alkali from the standpoint of pH control, brightness, and brightness stability.

TYPICAL RESULTS

Brightness levels achieved by the above processes will depend to some extent on the degree of purification and the brightness obtained prior to the peroxide treatment. Due to its mild (i.e., low temperature) action, steep bleaching appears to give best results for the amount of chemical used, but, of course, the system does not always fit in with existing mill procedures. Last stage high density results are shown in Table I. Tables II and III show steep superbleaching. Drier steep superbleaching results are as in Table IV.

Mention has been made of the superior aging characteristics of peroxide superbleached pulps. The brightness stability of such pulps, together with some hydrochlorite bleached pulps, is shown in Table V.

SUMMARY

From the proceding discussion it may be seen that hydrogen peroxide has a definite place in the production of high quality pulp with very high brightness and good brightness permanence. Further, it is felt that in many mills existing facilities will permit the production of these superbleached pulps with a minimum capital expenditure for equipment.

Central District (Empire State)

The last three meetings of the Central District were held at the University Club in Syracuse. One hundred and two people attended the February 5 meeting at which Jim Casey, chairman of the Testing Division and director of technical service of the A. E. Staley Manufacturing Co., Decatur, Ill., talked on "The Chemistry of Starch in Relation to Papermaking."

William Holl was the main speaker at the March 5 meeting which attracted 110 persons. He spoke on "The Manufacture of Tissues."

Frank B. Lincoln of Time-Life-Fortune Laboratories, Springdale, Conn., was the speaker at our April 2 meeting. One hundred and fifteen people listened to his discussion of "The Printing of Paper." An unusually enthusiastic discussion followed.

The Nominating Committee, consisting of Mr. Holl, George Martin, and William Trimble, named the following slate for the coming year:

Chairman—F. W. O'Neil
Vice-Chairman—Durward Geffken
Treasurer—R. G. Hitchings
Secretary—S. E. Church

This slate was elected unanimously.

S. E. Church, *Secretary*

D. B. Geffken, Oswego Falls Corp.; F. B. Lincoln, Time-Life-Fortune Laboratories; H. M. Gray, Oswego Falls Corp.; and F. W. O'Neil, College of Forestry

Northern District (Empire State)

John S. Hart, Head, Chemical Pulping Section, P
Paper Research Institute of Canada, spoke to 87 memb
guests of the Northern District, Empire State Sectio
Technical Association of the Pulp and Paper Indus
"The Va-Purge Process in Chemical Pulping" at its
monthly meeting held Thursday, April 8, 1954, at Gen
Glen Park, N. Y. Mr. Hart's paper was well received
audience. His paper is to be printed in the Technical
of *Tappi*.

D. Chace Mather and Ralph N. Prince spoke on
articles of organization and by-laws which will soon b
acceptance by the membership of the Empire State
It was reported that the balloting will be done by mail

James D. Parmele, chairman, Northern District, pr
the Nominating Committee's slate of candidates for
for the 1954–55 season. Those candidates are:

Chairman—Sheldon Young, Crown Zellerbach Corp., C
N. Y.
Chairman-Elect—Roger A. Schwartz, Knowlton Bro
Watertown, N. Y.
Secretary—Miss Elizabeth L. Case, J. D. Jenson Co.,
Bldg., Watertown, N. Y.
Treasurer—Paul A. Anderson, St. Regis Paper Co., 1
N. Y.

John H. Treadwell, Treadwell Supply Co., Wa
National Bank Bldg., Watertown, N. Y., was nominat
the floor to succeed himself as Treasurer.

It was announced by Mr. Parmele that voting for
trict offices will be conducted by mail.

The Ladies Night Committee announced that the
meeting will be held Thursday, May 13, at the Hote
ruff, Watertown, N. Y.

Mr. Parmele asked the members to keep the dates
10, 11, and 12 open for the Empire State Section annu
ing at Whiteface Inn.

Richard J. Murtaugh, *Sec*

Meeting of March 10, 1954

The most successful meeting of the season was at
101 members and guests of the Northern Distric
Empire State Section of TAPPI at its monthly mee
Wednesday, March 10, 1954, at the Hotel Woodruff
town, N. Y.

***J. S. Hart, Pulp and Paper Research Institute of
R. J. Murtaugh and J. D. Parmele, St. Regis Pa
J. H. Treadwell, Treadwell Supply Co.; and D. C.
Carthage Paper Maker Inc.***

Donald M. Ferguson, beater room superintendent, St. Regis Paper Co., Deferiet, N. Y., served as the moderator of the panel discussion on groundwood bleaching. Members of the panel were, Paul U. Bretschger, Buffalo Electro Chemical Co., Buffalo; Richard A. Dando, Central Technical Department, St. Regis Paper Co., Deferiet; Leo N. Poccia, groundwood superintendent, St. Regis Paper Co., Deferiet; Richard A. Premo, assistant general manager, Gould Paper Co., Lyons Falls; George V. Rittenhouse, Virginia Smelting Co., West Norfolk, Va.; and George E. Smedberg, E. I. du Pont de Nemours & Co., Niagara Falls, N. Y.

After a brief discussion on the history of bleaching groundwood by the moderator each member of the panel presented his side of the story. Following this part of the program the moderator opened up the meeting for the discussion.

Introduction to Panel Discussion of Groundwood Bleaching

D. M. Ferguson

There are two parts of this subject that will not be covered by the panel members, first, the history of groundwood bleaching, and second, the advantages gained by the use of bleached groundwood.

Literature on groundwood bleaching indicates very little was done until about 1934, at which time the Forest Products Laboratory reported a study of the use of oxidizing and reducing agents for bleaching groundwood. This work and subsequent work by du Pont in 1940 and 1942 reported oxidizing agents, namely, alkaline peroxides, were best. In 1941 St. Regis Paper Co. made the first extensive trial of bleached groundwood for magazine papers at Norfolk, N. Y.

The first extensive use of a reducing agent, namely, zinc hydrosulphite, was reported by the Powell River Paper Co. in 1948. Further reports by Virginia Smelting Co. in 1950 showed results of this bleaching agent over a 2-year period in a groundwood mill.

The use of bleached groundwood in printing grades of paper combines all the natural attributes of groundwood with the added advantage of brighter and better color. Tests show practically no change in strength characteristics, freeness, or milk with improved color, brightness, drainage, cleanliness, and absorbency. Opacity is lowered only slightly on bleaching.

D. M. Ferguson, Beater Room Superintendent, St. Regis Paper Co., Deferiet, N. Y.

Laboratory Evaluation of Groundwood Bleaching

R. A. Dando

The variables present in groundwood bleaching can only be partially evaluated in the laboratory. Many of these variables are inherent with the operation of the mill. Included in these are the age, quality, and species of the wood supply, the water supply, and operating characteristics of the mill.

The laboratory can determine the effect of pretreatment before bleaching, the effect of additives during bleaching, variations of percentages of bleaching chemical, and the optimum formulation of the bleaching liquor.

The effect of bleaching density, temperature, and retention times can be studied for any type of system in the laboratory.

In order to predict the brightness of the bleached groundwood to be expected in the mill, many other variables such as the type of mixing equipment available, the size of the laboratory bleach batch, the quality of the dilution water, the method of sheetmaking used in the laboratory, and many others must be considered.

The best bleach plant for a given mill must be dictated by the maximum brightness necessary and the economics of the processes available. Since laboratory-bleached pulp will only give an indication of the brightness obtainable at a given chemical cost because of the many variables existing between the laboratory and actual mill operation, and the variations existing between various mills, a mill trial of a bleaching method is the only good way of determining the best bleach process for any one mill.

R. A. Dando, Central Technical Department, St. Regis Paper Co., Deferiet, N. Y.

Peroxide Bleaching of Groundwood at Gould Paper Co.

Richard A. Premo

Peroxide bleaching of groundwood is a simple process which includes the following four basic operations: (1) preparing the peroxide solution, (2) mixing the peroxide solution with the pulp in controlled proportions, (3) retaining the peroxide treated pulp long enough to permit bleaching to go to completion, and (4) reducing the residual peroxide and neutralizing the bleaching pulp to the pH desired for the paper furnish.

The chemicals used in the process include hydrogen peroxide or sodium peroxide or both, sodium silicate, sulphuric acid or caustic soda, magnesium sulphate, and a reducing and neutralizing agent such as sulphur dioxide, sulphite cooking acid, sodium metabisulphite, or sodium bisulphite.

In our system the pulp is metered at a controlled consistency and pumped to the thickener. The sheet of thickened pulp is shredded and dropped to the conveyor which collects the pulp from across the discharge face of the roll and drops it into the single-shaft mixer where the pulp is mixed with steam to obtain a pulp temperature of approximately 110°F. From the single-shaft mixer the heated pulp passes into the double-shaft mixer where the peroxide bleaching solution enters the process at this point and is well mixed with the pulp in passing through the double-shaft mixer. From here the pulp drops by gravity into a retention tower where it remains from $1^1/_2$ to 3 hr. At this point the pulp pH is 9.0 to 9.5 with a residual peroxide of about 10%.

The pulp is then taken from the tower by a scraper and metering-type screws and neutralized with sulphur dioxide in the neutralization chest. In this step sufficient sulphur dioxide is used to reduce the pH to 6.5 to 7 which is ample to eliminate any residual peroxide. From the neutralization chest the pulp is pumped at a controlled consistency to storage.

The continuous method of preparing the sodium peroxide bleaching solution involves the flow of water at a metered rate through a four-compartment stainless steel tank (10 by 3 by 3 ft.). Each compartment is equipped with a stainless steel agitator. Epsom salt, added from a dry feeder, is dissolved in water by-passed from the meter and returned to the first compartment. Sodium silicate is also added to the first compartment. The sodium peroxide is added to the second compartment by a loss-in-weight dry feeder. Sulphuric acid is added to the third compartment. The bleaching solution overflows the fourth compartment which serves as a sampling reservoir and flows to a tile storage chest.

The continuous method of preparing a peroxide bleaching solution from hydrogen peroxide involves the flow of water at a metered rate through the same size compartments as previously described. Epsom salt and sodium silicate are added to the first compartment, caustic soda is added to the second compartment, and hydrogen peroxide is introduced in the third compartment. The bleaching solution overflows

Richard A. Premo, Asst. General Manager, Gould Paper Co., Lyons Falls, N. Y.

the fourth compartment which serves as a sampling reservoir and flows to a tile storage chest.

In the continuous method of preparing a sodium peroxide-hydrogen peroxide combination bleaching solution, the flow of water is at a metered rate through the same size compartments as shown in the other systems. Epsom salt and sodium silicate are added to the first compartment. The sodium peroxide is added to the second compartment by a loss-in-weight dry feeder. Hydrogen peroxide is added to the third compartment. The bleaching solution overflows the fourth compartment and flows to a tile storage chest.

We at Gould Paper Co. have a great deal of respect for the continuous method for preparing the peroxide bleaching solution, as it (1) has simplified the chemical handling necessary in operating the bleachery, (2) it minimizes the active oxygen losses by being able to operate with a small amount of bleach liquor in storage, and (3) cost of the equipment is lower than necessary to operate the batch system.

The use of peroxide bleach groundwood has upgraded our paper enabling us to make sheets having a G.E. brightness of 68 and better using our own pulp which previous to peroxide bleaching was out of our range of distribution potential.

Peroxide bleached groundwood has increased our mill potential by enabling us to make a wider range of specialty and printing papers.

In view of these facts we at Gould Paper Co. believe that the introduction of peroxide bleached groundwood to the paper industry has opened an entirely new field for groundwood printing papers and specialty.

High Brightness Bleaching of Groundwood Pulp with Zinc Hydrosulphite

G. W. Rittenhouse

During the past few years, zinc hydrosulphite has become a leading and most effective bleaching agent for groundwood pulp. There have been various papers presented in the past, discussing various phases of zinc hydrosulphite bleaching. None of these have presented a method for obtaining high brightness increases. The Virginia Smelting Co., the leading manufacturer of zinc and sodium hydrosulphite, has conducted an intensive research program over the past 3 years in order to determine the true values of hydrosulphite bleaching. Our research on groundwood bleaching has now reached the stage where it can supply the paper industry with a simple method for achieving 6 to 13 points brightness gain for as little as 60¢ per unit of brightness per ton of pulp.

In order to predict these brightness gains, certain variables must be considered. These variables are: pulp consistency, pH of stock, temperature, reaction time, concentration of zinc hydrosulphite, iron content of the pulp and process water, and the wood specie.

It is to be expected that in increasing the consistency whereby both the concentration of pulp and hydrosulphite are increased, a more rapid and complete reaction would be obtained. In the past, this has often not been the case, probably due to poor control of bleaching conditions. Experience has now shown that with proper control during bleaching, good results can be obtained at consistencies up to 15%.

It has been found that the most effective pH range for bleaching is between 5.0 and 6.5. Excessive alkalinity, in other words in the range above 7, will cause a yellowing of the pulp which is not removed by the bleaching agent. On the other hand, reaction pH's below 4.5 will promote decomposition of the hydrosulphite in competition with the bleaching reaction.

G. W. Rittenhouse, Virginia Smelting Co., East Norfolk, Va.

The reaction temperature at which a bleach is cond has pronounced influence on the brightness gain of zinc h sulphite bleached groundwood pulp. For each 20 t increase in reaction temperature, other conditions bein stant, approximately 1 point of brightness gain can b tained. It should be emphasized that the maximum b ness obtainable in any practical period of operation is l by the temperature of the reaction. For maximum b ness gain with a minimum reaction time, the highest tem ture consistent with good economy of operation is des The response of groundwood pulp, when bleached with h sulphites, to increased temperature is an important adva of this bleaching technique. In many mills, the brig requirements of the pulp stock vary. Without changi mill equipment to increase the holding time, and witho creasing the amount of bleach chemicals, increased b nesses may be obtained by merely increasing the re temperature.

The effect of reaction time on the brightness gains hydrosulphite bleached pulp is dependent on the re temperature. Generally speaking, a large portion brightness gain achieved in bleaching groundwood is ob in the initial part of the reaction period. At 165°F., 9 the maximum bleach is obtained within the first 15 reaction, whereas at 90°F. the brightness gain is more ual, requiring about 1 hr. to achieve 90% of the ma bleach. It is important to note that at each reactio perature, a specific maximum brightness level is obtain other words, the brightness curves become asymptotic time axis. The brightness gains at 90°F. never appro maximum gains at higher temperatures. This may p be due to the fact that at higher temperatures a greater ing potential is developed and certain color bodies ar susceptible to reduction at elevated temperatures. I cases, a reaction period of 30 min. to 1 hr. is preferred best bleaching within this period, temperatures of and higher should be employed. Increasing the hy phite concentration results in increased brightness ga given set of bleaching conditions up to approximat zinc hydrosulphite, based on the dry weight of th Beyond the 1% concentration, there is little gain i ness that can be justified economically in most cases effect is most pronounced at higher temperatures, s 140°F.

Wood Species: In the due process of our laboratory we have run bleaches on various wood from different s of the country. All the types that we have tested r very well to zinc hydrosulphite bleaching.

Iron Content: It has been found that small amo iron in the pulp and process water will have a dele effect on the brightness stability of the bleach. In o control this action, it is recommended that a seque agent, such as sodium tripolyphosphate, be used dur bleaching process. This sequestering agent not only c the iron, but seems to increase the efficiency of the ing action. Generally speaking, 1 to 2 points of ad brightness are obtained by use of the phosphate. Th of addition of the polyphosphate is not critical. It added either before or after the bleach.

Heretofore, all the information which we have pr has been based on laboratory studies, and while we re the value of laboratory work, still the pay-off is how work in the plant? We have devoted a great deal of full plant studies and happily the plant results are ge superior in brightness gain to the laboratory exper This, of course, is not at all unusual. Zinc hydrosul easy to use in the plant and works well in both sma integrated mills and large, continuous production There are several methods which may easily be emplo knowing the reaction conditions. In smaller mills, a or chest may be used as the bleaching chamber. T

in the beater is heated to the desired temperature. Next, the proper amount of bleaching chemicals is added. After the beater has mixed the pulp and chemicals, it is shut off and allowed to stand for the required retention time. No other process is necessary. For larger integrated mills a regular low or medium density bleach system may be used. The zinc hydrosulphite is made up as a continuous fresh solution by means of a dry feeding device. This solution is pumped to the mixing chamber, where it is mixed with the pulp. Next, the pulp is pumped to the retention chest. The sodium tripolyphosphate is also added in solution form and may be prepared and added the same way as the hydrosulphite solution.

Several months ago, we had the opportunity to conduct a closely controlled mill scale run where we bleached over 1000 tons of groundwood pulp in a typical low density system. This trial gave us the added opportunity of comparing the zinc hydrosulphite method of bleaching with the peroxide system. This mill had been bleaching with peroxide for several years with a regular low density bleach plant. The peroxide method employed the regular peroxide bleach formula. The bleaching conditions for the zinc hydrosulphite bleach were as follows: the temperature range was between 120 and 150°F. The average retention time was about 45 min. The pH was rather constant between 5.0 and 6.0. One per cent zinc hydrosulphite and 0.5% sodium tripolyphosphate were used throughout. The results were very gratifying and superior to the peroxide bleach process both in brightness gain and cost. An examination of the cost figures may be of interest. The total cost of bleaching with zinc hydrosulphite is less than $6.50 per ton. This figure includes the chemical cost and the additional steam cost to heat this low density to the desired bleaching temperature. This means that the cost per point gain per ton of pulp is a little more than 60¢.

The years of research and plant work spent on hydrosulphite bleaching have been most fruitful and we believe that this work represents a real contribution to the pulp and paper industry. This work has established the fact that it reduces bleaching to produce high brightness levels which are permanent and low in cost when compared to the other methods of bleaching. The utilization of the hydrosulphite bleach in the mill is simple and straight forward. No expensive, special equipment is needed and a whole host of auxiliary chemicals, troublesome to handle, are eliminated when hydrosulphites are employed.

Peroxide Bleaching of Groundwood

G. E. Smedberg

Initial peroxide bleaching installations were all low (4 to 6%) consistency batch processes. The first continuous low consistency groundwood bleaching process using a conventional launder-type tower was installed in 1947. Recently a continuous low consistency process was developed which consists of one or more agitated tanks connected in series for retention of the pulp during the bleaching cycle. This low cost bleaching equipment has its greatest value in low capacity bleacheries. The time saved in filling and emptying the tanks which is eliminated by the continuous process as compared to the batch processes results, for the same capacity, in a one-third reduction in the space required for the bleachery.

Recent developments in equipment design for the medium consistency (12 to 15%) bleacheries have resulted in changes in the tower design and type of pulp-peroxide solution mixer. These changes have been made for the purpose of reducing the initial bleachery cost without sacrificing chemical efficiency.

Pretreating the groundwood with calcium chloride or sodium tripolyphosphate prior to peroxide bleaching has resulted in a 20% or more increase in the process efficiency. The improved efficiency has been reflected in a higher bleached pulp brightness or reduced peroxide consumption for the same brightness.

Recent laboratory investigations have further verified the known importance of bleaching the groundwood or darker portion of the furnish to obtain a high mixed pulp brightness. The work has shown that the mixed pulp brightness is more dependent on the brightness of the groundwood or darker portion of the furnish than heretofore realized or indicated by available rules for calculation of mixed pulp brightness.

High Density Groundwood Bleaching with Hydrogen Peroxide

Paul U. Bretschger

This paper deals primarily with high density bleaching of groundwood pulp using hydrogen peroxide as the bleaching agent. In this instance, high density will be defined as 20% moisture-free or higher.

Bleaching groundwood pulp at higher densities has many distinct advantages. Some of these advantages are as follows: (1) Bleach efficiency increases with an increase in density, allowing either higher brightness at the same chemical levels or equivalent brightness at lower chemical levels. (2) High density in many cases is the only way to obtain high peak level brightness, irrespective of chemical dosage. (3) Steam requirements are reduced by about $^4/_5$ over low density systems to obtain the same temperature level. (4) Total volume of pulp and water handled is greatly reduced.

For relatively low capacity mills and for those shipping pulp to another mill, the high density cold steep process has proved very satisfactory. Where feltless wet machines are available, alkaline peroxide solutions are applied continuously to the pulp web, and the pulp is then allowed to stand in rolls or lap form for storage or shipment.

Screw-press type of dewatering equipment is also used commercially for the cold steep process. In this form of bleaching the pulp is handled in crumb or nodule form. With this type of equipment, a continuous tower process is also used. Efficient bleaching can be accomplished in 1 to 2 hr. at 90 to 115°F.

Typical of results obtained in mills using the Becco cold steep system with 1.0 to 1.3% (H_2O_2 50%) and 4.0 to 4.5% silicate 40° Bé are unbleached groundwood brightness ranging from 57 to 60 points G.E. to bleached groundwood bright-

Paul U. Bretschger, Becco Sales Corp., Buffalo, N. Y.

Leo N. Poccia, St. Regis Paper Co.; Paul U. Bretschger, Buffalo Electro-Chemical Co.; George V. Rittenhouse, Virginia Smelting Co.; Richard A. Premo, Gould Paper Co.; Richard A. Dando, St. Regis Paper Co.; George E. Smedberg, E. I. du Pont de Nemours & Co.; and Donald M. Ferguson, St. Regis Paper Co.

E. Smedberg, E. I. du Pont de Nemours & Co., Niagara Falls, N. Y.

nesses ranging from 70 to 72. These figures are averages for long-term operation.

It should be noted that as consistency of bleaching increases, the caustic alkali requirement decreases. As in the previous examples, only hydrogen peroxide and sodium silicate 40° Bé are required, both liquid chemicals. In a relatively few cases, more alkalinity is required than that supplied by the silicate alone, although a maximum of 0.25% caustic is the rule.

In such cases, if an all-liquid preparation and handling system is desired, hydrogen peroxide, sodium silicate 40° Bé, and liquid caustic 50% may be used.

However, the required small percentage of caustic alkali may be obtained through the use of the mixed peroxide system where sodium peroxide and hydrogen peroxide are used in the proper proportions to give the desired level of caustic alkali. This system is primarily of use in low and moderate density operations.

Pretreatment chemicals such as tetrasodium pyrophosphate, sodium tripolyphosphate, calcium chloride, etc., apply to high density bleaching systems as well as to low and moderate bleaching systems for increasing final bleached pulp brightness.

In summary it should be stressed that groundwood pulp may be bleached with alkaline peroxide solutions at low, moderate, or high density. However, from the foregoing statements it is evident that as density increases, bleaching efficiency increases; thus, lower chemical levels, lower cost, as well as lower steam requirements are found.

D. B. Geffken: Will peroxide bleaching remove dirt from pulp?

G. E. Smedberg: It cannot be said definitely that peroxide bleaching will remove dirt from pulp. But, one mill has reported less dirt in their pulp after peroxide bleaching.

D. C. Mather: What can we expect to happen to our mill equipment as a result of using calcium chloride as a pretreatment chemical when we see what happens to our cars because of the calcium chloride used on the roads?

Mr. Smedberg: The use of calcium chloride as a pretreatment chemical for peroxide bleaching just does not cause corrosion. We have had no complaints. The concentration of calcium chloride is very low.

Richard A. Premo: We have used calcium chloride as a pretreatment chemical for some time and have not noticed any corrosion.

J. C. Parsell: Does a difference in oxygen content reduce the effectiveness of the zinc hydrosulphite?

G. V. Rittenhouse: No.

D. M. Ferguson: What is the maximum brightness we can expect to obtain from any bleaching agent using reasonably clean wood and water? Can we get a 74?

P. U. Bretschger: That will be influenced by all of the factors in the mill. But, we would say that a 74 would be possible.

Mr. Ferguson: Would we have to go up to 3% peroxide?

P. U. Bretschger: That is possible.

Mr. Smedberg: With a poplar groundwood of 60 brightness a final brightness approaching 80 has been obtained using 3% peroxide.

Mr. Rittenhouse: On a laboratory scale we have bleached with zinc hydrosulphite to 73 to 75.

A. S. Gard: At the end of the retention time using zinc hydrosulphite can one detect traces of free zinc hydrosulphite?

Mr. Rittenhouse: No.

J. D. Parmele: Does the combination of time and temperature cause reversion of zinc hydrosulphite bleached groundwood during storage?

Mr. Rittenhouse: Week-end storage of zinc hydrosulphite bleached groundwood does not result in reversion.

Mr. Geffken: What determines the optimum alkalinity to be used?

Mr. Smedberg: The conditions in the mill.

Mr. Geffken: What is the action of the pretreatment chemical?

Mr. Smedberg: We think it ties up the iron in the system. However, from experience we know that mills which use hard water usually do not have to employ a pretreatment chemical.

J. D. Moore: How closely can brightness be controlled?

Mr. Premo: The brightness of bleached groundwood can be duplicated from day to day provided the starting brightness of the unbleached groundwood remains constant.

Mr. Geffken: Why do you promote the use of mixe oxides when straight peroxide is a cheaper bleaching medi

Mr. Smedberg: The primary reason is because when mixed peroxides the use of sulphuric acid and all of the c inherent thereof are eliminated. Mixed peroxides mak safer.

Mr. Bretschger: Iron, which is detrimental, is kept ou system when sulphuric acid is not used.

R. P. Fallon: How come only calcium chloride or s tripolyphosphate are used as a pretreatment chemical?

Mr. Smedberg: From experimentation we found th cium chloride or sodium tripolyphosphate does the job than other chemicals. Calcium chloride is less expensiv sodium tripolyphosphate. Usually the individual mill mines which one it wants to use.

R. A. Dando: In reply to a question some time ago I like to say that the wood species used for bleaching is ve portant.

Mr. Ferguson: Will zinc hydrosulphite operate at 15% sistency in the mill.

Mr. Rittenhouse: We have successfully bleached wi hydrosulphite in the laboratory at 15%. We have ma mill trials at 15%. One mill trial using 1% zinc hydros and 0.5% sodium tripolyphosphate was comparable peroxide. The other mill trial did not duplicate the bri obtained with 2% peroxide. We have been working on ing at moderate consistency—15%—for the past year or

Richard J. Murtaugh, *Secre*

Empire State (Eastern District)

Pulp evaluation was discussed by a panel of members Eastern District of the Empire State Section of TAPPI regular meeting at Milfranks, Thursday night, Mar Members of the panel, and the committee which laid t for the accumulation of material, represented paper from Mechanicville to Plattsburg, and a most infor session was held. It was announced that the regula meeting will be held April 22, the fourth Thursday ins the third. The May meeting, to which the members n vite ladies, will be held May 19.

Earl H. Johnson, chairman of the Empire State awa test, announced that there will be four papers presented entrants in the contest. The judges for the contest Robert Blakeslee, Imperial Paper and Color Corp., Falls; Grant Cole, Diamond Match Co., Plattsbu Dallam Blandy, American Wood Board Co., Schuyler

Jack Winchester, assistant to R. G. Macdonald, Sec Treasurer, National TAPPI, attended the meeting on of the national staff, and spoke briefly. Robert Drum International Paper Co., Glens Falls, announced the meeting of the Empire State Section at the Whitefa Saranac Lake, June 10, 11, and 12.

A wide range of standard and substitute tests for pul kinds was discussed by a panel of which the moderator N. Hagar, Diamond Match Co., Plattsburg. Some ne were suggested and new applications of old tests discuss

The preparatory work for the discussion was done by mittee consisting of Mr. Cole, chairman, and W. H. H New York and Pennsylvania Co., Willsboro; Harold West Virginia Pulp & Paper Co., Mechanicville; Davis, Finch, Pruyn & Co., Glens Falls; and James II, J. and J. Rogers Co., AuSable Forks.

The speakers on the panel were Mr. Johnson; Hugh I International Paper Co., Palmer; Paul Page, Imperial and Color Corp., Plattsburg; and J. W. Dappen, Ma Paper Co., Fort Edward.

Mr. Cole, vice-chairman of the district who preside introduced by J. W. Crocker, chief engineer, The San Iron & Brass Works, Hudson Falls.

Allen A. Lowe, *Publicity Chair*

PULP EVALUATION METHODS AS PRACTICE LOCAL MILLS

Grant G. Cole: Shortly after John Crocker, chair

the Eastern District, Empire State Section of TAPPI was elected to office in early 1953, he proposed that a project of a type to benefit the most members within the district be undertaken. The thought behind this proposal was to unite the group in a specific enterprise, thus strengthening the organization, and, as a result, to produce information which would be of actual benefit to all concerned.

The first step toward this goal was to ask Grant Cole, vice-chairman, if he would give the matter thought and take whatever action that might be indicated. At the annual organizational meeting in September, 1953, considerable discussion led to the decision that pulp evaluation was a problem common to all Eastern District mill members. It was decided that the chairman of the newly formed committee, Mr. Cole, should be allowed to use his own judgment in organizing a program based on this subject and to have it presented at the regular March, 1954, meeting. In order that everyone be fully represented in the project, a technical man from each of the area mills was asked to be a member of the committee. The response was highly gratifying.

It might be mentioned that the Eastern District has within its boundaries quite diversified types of paper production—printing papers, wall papers, tissues, and groundwood specialties to name only a few. The committee soon established the fact that the pulp evaluation program could not be limited to any one type of fiber or else interest in the project would be definitely lacking in those members not using that fiber. Thus the final plans became crystallized to have four speakers chosen from the original committee—each to discuss in a maximum of 15 min. the means of evaluation of pulp in his own mill and to mention the problems that exist in the use of the pulp involved that necessitate such evaluation. Emphasis was placed that too detailed an explanation of the fiber's role beyond the slurry or lap pulp stage should be avoided. Evaluation methods known to have been previously described in any literature were to be shunned unless definite variations of these methods were in use. At this stage, it became apparent that routine control methods as applied to pulp testing were what was desired. In order that all the committee members could take an active part in the program, the ones not presenting papers were given the opportunity of reading those of the four speakers at a date prior to the meeting. The "inactive" group was far from what is implied, for they were to form the nucleus of a discussion period to be presided over by a moderator. These men were also to mention pulp evaluation methods of their own.

All in all it is felt that this program was successful in accomplishing its intended purpose of providing practical ideas to the local membership. In a bigger sense, these methods can be used directly or indirectly by anyone engaged in pulp evaluation. With this in mind, the four discussions are presented as given by their authors.

Earl H. Johnson (Chemical Director, Stevens & Thompson Paper Co., Greenwich, N. Y.): Pulp evaluation is a large subject and it could take considerable time and be examined from a number of different angles. I know that many of you will have your own particular problems related to pulp testing and they may not be the same as mine. However, I am going to give you a brief description of what we do at Stevens and Thompson in the way of pulp evaluation and if I do not touch on your problems, perhaps one of the other members of the panel will do so.

Stevens and Thompson Paper Co. is a manufacturer of soft tissue papers which are used for toilet tissue and paper napkins. As such, we use groundwood, bleached and unbleached sulphite, bleached soda, and bleached kraft pulps. We manufacture our groundwood and purchase the other pulps. Our pulp testing problem, therefore, is one of testing and controlling our grinding operation so as to make the kind of pulp we want and of testing samples of market pulp to determine which grades are suitable for our use, and then testing shipments of such pulp to make sure they have the properties we found in the samples on which the purchase was made.

The methods of pulp evaluation which we use to accomplish these ends are listed below. They are:

1. Freeness test. This is a Canadian Standard freeness test. It is a Standard TAPPI test and needs no discussion.
2. Moisture test. We use a standard moisture test and also a quick moisture test which I will describe.
3. A test to determine the way in which a pulp will defiber in our plant equipment.
4. Brightness test. We use a quick test for brightness which will be described.
5. Strength tests. We use tear and burst tests and the only variation from TAPPI procedure is in the method of forming handsheets which will be described.
6. Softness test.

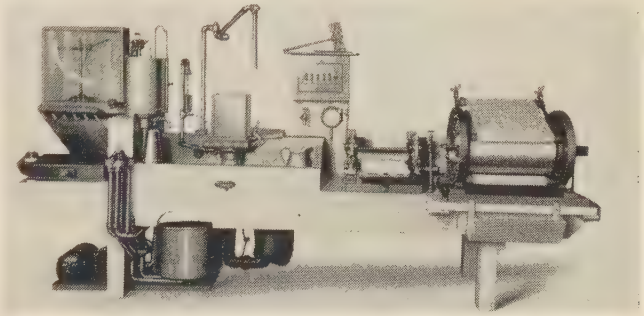
Quick Moisture Test

For this test an ordinary laboratory oven which is thermostatically controlled and has an air vent in the top has been equipped with a pulp balance placed on top of the oven. Then a wire has been added to the left-hand side of the balance extending through the air vent into the interior of the oven where the balance pan is attached. A counterweight to balance the added weight of the wire has been placed on the right-hand pan. The balance used is sensitive to 1 mg. and in the usual determination, the dried sample is weighed to the nearest 10 mg. The test is carried out as follows: a sample of the pulp to be tested is weighed on an analytical balance to the nearest 10 mg. It is then dried either on the Noble & Wood sheet drier or on the hot plate. When it is nearly dry (a matter of 2 to 5 min.) it is placed on the pan in the oven and dried until there is no more loss in weight. The test takes about 15 to 25 min., depending on how much moisture is in the sample.

Comparison of results with a standard moisture test shows that it gives results which are within 0.3% or less of those obtained by the standard test. This degree of accuracy is adequate for most of the moisture determinations which we make. If one chose to dry the sample for an hour or two, the results would be as accurate as the standard test. This equipment can also be used to make a quick consistency test of a pulp slurry. To do this, some 11-cm. filter papers are previously dried on the balance to an oven-dry state and the oven-dry weight is marked on the paper. Then a measured volume or weight of the pulp slurry is filtered onto the paper in a Buchner funnel. The paper plus pulp is pressed and then dried in the drier and is then placed on the balance pan and dried to constant weight. Then the weight of the filter paper is subtracted and the consistency calculated. This test usually requires about half an hour.

Quick Brightness Test

Because the water supply available has some effect on brightness (this is due at least in part to the large amount of water used in making handsheets), we do not test for brightness on handsheets. Instead, we defiber the pulp with distilled or demineralized water and then filter it onto a filter



Noble and Wood sheetmaking apparatus

paper in a Buchner funnel The filter paper and pulp are then transferred to a bleached blotter and the filter paper is peeled off. Another blotter is put on top and the whole is pressed. Then the blotters are transferred to the sheet drier at 220°F. and dried. Brightness is then determined on the sheet of pulp using a Photovolt brightness meter.

Defibering Test

Because we have no refiners in our pulp preparation system and use our jordans as lightly as possible, it is necessary that the pulps which we use will defiber completely in our hydrapulpers or breaker beaters. If we are considering the use of a pulp which may be hard to defiber, we make a test using 6 grams air-dry pulp in 500 ml. of water in a Waring Blendor. If it defibers completely in 40 sec., we know it will be satisfactory. If it takes longer than that, we can expect trouble in the plant.

Method of Making Handsheets for Strength and Softness Tests

For this purpose, we use a Noble and Wood sheet machine which is illustrated in the figure. You will see that it consists of a hot plate for rapid drying of sheets, a proportioning tank which is calibrated, a sheet mold which uses 9-in. square 100-mesh Monel metal wires, a press with appropriate felt, and a rotating electrically heated drum drier which carries a drier felt. The press is equipped with lever arms and weights and the weight placed on the arms can be adjusted to give whatever pressed consistency is desired.

To make a pulp test, we take a weighed amount of dry pulp or equivalent amount of wet pulp and defiber it in the Waring Blendor for 40 sec. The slurry is put into the proportioning tank and diluted to 18 liters. The consistency in the proportioning tank is 0.013%. Two quarts of this slurry will give a sheet of TAPPI Standard basis weight, namely 42.7 lb. 25 × 40—500.

The maker of this machine recommends that the sheet on the wire be pressed in the press felt and then the wire and sheet be transferred to the drier and dried. The sheet is then peeled off the wire after drying. I do not like this procedure for two reasons. One is that with some pulps and particularly with lightweight sheets, it is very difficult or impossible to remove the sheet from the wire after drying. The other objection is that when the sheet is dried on the wire, it has no chance to shrink during drying and so represents a drying condition which does not exist on a paper machine.

Consequently, we have adapted the method of placing a lightweight piece of blotting paper 10 by 10 in. on the press felt and of placing the wire from the sheet mold with the formed handsheet in contact with the blotter and then pressing this combination. During pressing, the handsheet transfers to the blotter and after pressing the wire is pulled off. Another blotter is placed on top of the sheet and the sandwich is then dried in the sheet drier. In this way, sheets of 10 lb. basis weight or lighter can be made and peeled off the blotter after drying. This technique works well in most cases but in making 10-lb. sheets from some groundwood pulps which have a great tendency to stick to the wire, it is not possible to transfer them to the blotter. For this situation, we keep a few wires which have been coated with "Desicote" (a water-repellent material made by Beckman Instrument Co.). Such wires permit the transfer of any groundwood pulp which I have tested to the blotter.

In addition to TAPPI Standard basis weight sheets we also make 10-lb basis weight sheets in our pulp evaluation testing by draining out the proper volume of slurry into a graduated cylinder.

The handsheets made as described above are conditioned under standard conditions and the heavy sheets tested for tearing strength and burst and the 10-lb. sheets are tested for softness and examined for texture and cleanliness.

Using such pulp testing methods, we have evalu large number of pulps and have correlated the results w perience in our mill so that we can make a test on ar ticular pulp sample and predict with a fair degree of ac whether it will or will not be satisfactory for use in our

Hugh Lavery (Assistant Chemist, International Pap Corinth, N. Y.): As previously mentioned, each mill own pulp evaluation problem and much depends on wh of paper you are trying to make. At our mill, we worl ward from the paper to the pulp to evaluate pulps; search, pulp evaluation is for pulp characteristics in selves and the full time-consuming TAPPI Standard m are used. At the mill, we do TAPPI Standard moist incoming pulps for an obvious economic reason; ar own modification of TAPPI Standard to insure that w the pulp we receive at the beater room and to note cha incoming pulp. From an evaluation standpoint, the results have been and are being tied in indirectly with quality and machine operation.

Our equipment at the mill includes the following:

- Lightnin' mixer and 1.5 to 3.1 beakers for pulps easy t up.
- Valley Iron laboratory beater for pulps difficult to b and for hydration.
- TAPPI Standard sheet mold, standard blotters, press plates, and hot air fan.
- Constant humidity room at 50 R.H. at 70°F. or a de with desiccant to maintain a rough 50 R.H. at 70°F
- Canadian Standard freeness tester, Mullen tester, tea G.E. brightness tester, microscope (100×), Buchner (11 cm.), and filter paper.
- TAPPI Standard sample drill bit.
- Drying ovens, analytical balance, etc.

It might be said that we test four types of pulp: (1 make sulphite, (2) incoming groundwood, (3) ow groundwood, (4) incoming strength pulps.

On our own-make pulps, we do an initial or zero fi burst, tear, brightness, and handsheets for visual inspe specks and color as routine tests on stock to beater The first four are TAPPI Standard modified only to the of meeting our operation. In the sulphite mill, the p pulp evaluation test is the TAPPI permanganate n the groundwood mill, the principal pulp evaluation t blue-glass in the hands of a foreman, and even though not give figures, it is a first class evaluation test whe hands of a competent man. With the exception of t glass test, all the above handsheets and test data ar able together with paper machine operating data an tests for pulp evaluation. When there is question on wood evaluation at a later date—perhaps the next comparative evaluation of the blue-glass test can be m using the groundwood brightness pads for microsc amination at 100×.

On incoming pulps, moisture is a must. Except for l lically pressed laps, we use modified TAPPI Standar modification is chiefly in the per cent of units teste exception on hydraulically pressed laps is that, instea ing the wedge method, we use a drill method. We dri center of the lap in the following sequence—one un center, three units on diagonal one-half way from ce corner, and five units near corner. Test results che with the wedge method. All else is as TAPPI.

When it is desired to get a quick approximation of m (air-dry pulp) for use of pulp to beater, a Canadian suggested a quick test. Slurry a known weight of p known volume of water, filter an aliquot part onto a filter paper, dry between the surface of a hot plate an iron, weigh and calculate back to per cent air-dry sample. It is surprising how closely you can come TAPPI results if you roughly proportion your origin ples—one from center, three halfway, and five near edg

On all incoming pulps, we do initial freeness, initia initial tear, initial brightness, and handsheets for c

dirt. Also, the tester examines the pulp for specks and mold. If either of these are excessive, he immediately brings these pulp samples for further inspection.

When we are dealing with strength pulps new to us and we do not have research's data on hand, or when we have a supplier whose history has not been good, we do modified TAPPI beater tests to under 500 freeness (even though our beater may not be in perfect condition) and do bursting strength and tear in the handsheets. From this, we can give warning to the paper mill and do comparative evaluation.

At present, we are experimenting with opacity and zero-space tensile test evaluations, and wish we had a good, simple means of evaluating fuzziness in strength pulps.

Paul L. Page (Imperial Paper & Color Corp., Glens Falls, N. Y.): Most of our pulp is evaluated according to TAPPI Standards but there are times when we find it advantageous to deviate from those standards for some specific problem. There are two obvious reasons why we might deviate from the standard tests. One reason is when TAPPI has no standard test which would investigate the pulp properties we wish to study. The other reason is economics. Sometimes it is not economical to buy or build a standard TAPPI test for using just a short time while studying one small problem. The two tests I am going to describe are not our routine tests but some that we have made and used on past mill problems. They are (1) a drainage test and (2) a test for air in the headbox stock. Similar tests have been written up in TAPPI Routine Control Methods but we deviated from those either for simplicity or to give us a slightly different end result.

The drainage tester, as the name implies, was used to study the drainage of the pulp at various points in the mill. This tester could be modified to fit your existing need. It consists of a 2-in. i.d. cylinder, 13 in. long threaded at both ends. A cap with an air cock is fitted to one end and the male section of union joint to which a trap, made of $^3/_4$-in. pipe, is fitted to the other. A piece of machine wire, cut in a circle equal to the outside diameter of the cylinder and placed between the cylinder and the union joint, acts as a screen.

The pulp is diluted and agitated before it is added to the cylinder from the bottom or screen end. The screen is then placed in position, the trap screwed on, and the cylinder uprighted. When the air cock is opened, the flow starts. We measured the time required to collect 500 ml. of water. At the end point there is about 3 in. of water above the sheet but we found we could reproduce the results much better this way than if we tried to draw too close to the wire. Enough pulp, 0.2 gram, was used to form a 14-oz. sheet on the screen. That is the heaviest sheet we produce and, at the time of investigation, it was draining very slow on the machine. This tester gave very good results. Its normal deviation was less than 2% when the same pulp was used to run repeated tests. The largest variations or errors were due to incorrect consistencies. Varying the amount of pulp used in the tester makes an appreciable difference in the drainage rate.

The drainage tester, as we used it, was of little value on free stocks. Its real value was on slow stocks. We use the Canadian Standard freeness tester as a routine control instrument and it was used as a comparison for evaluating the drainage tester. On a free stock, freeness values from 300 to 500, small changes in the stock show as large changes in the freeness values; but, with slow groundwood stocks where the freeness values are between 50 and 100, the variations in the freeness test results were found to be greater than the pulp changes we were looking for. A tester that has greater variations than the process is of little value for making a study like we were attempting to do.

The drainage tester worked in reverse of the freeness test. Very free stocks gave very low drainage values and the variations in the tester were greater than the variations in the stock; but, with the slow groundwood stock, the drainage values were high. These high drainage values were influenced by small variations in the stock and now these variations in the process, which could not be found with the Canadian Standard freeness test, could be observed.

Plots disclosed that, as you would expect, the drainage rate was inversely proportioned to the freeness. An unexpected observation was that the groundwood showed a different relationship between drainage and freeness than the headbox. Equal freeness tests gave higher drainage readings with the headbox stock than with straight groundwood. It was unfortunate we did not have a classifier available for this work but I believe that if we had had a classifier available, it would have shown that the drainage rate was more influenced by fines than the freeness. A straight line relationship was obtained between white water consistency and headbox drainage.

We did not take the time to make an intensified study of the drainage test. We only used it for 1 month in connection with a mill problem but we found it quite useful and I am passing the information along in case that sometime you too might have use for such a test.

Another test we used in connection with this same problem was a quick method for determining the entrained air in the headbox stock. The stock was siphoned from the headbox with a $^1/_2$-in. copper tube into a preweighed pint jar. The tube had a shut-off on the outside so that after the initial priming, all we had to do to start the flow was to turn on the valve. The stock was allowed to flow for a couple of minutes before the sample was collected. The jar was held so that the tube extended to the bottom of the jar and the stock could gently fill it. Before the jar was withdrawn, the stock overflowed the jar for about a minute and all surface foam had flowed over the side. The top was gently put on the jar and the ring screwed on. The outside of the jar was washed and wiped dry before weighing.

A larger sample of stock was obtained in a bucket and roughly weighed. This stock was gently boiled for about a half hour, the lost water replaced, and the stock brought to a boil again to remove all the entrained air. This stock was then cooled to the same temperature as the original headbox sample. The stock was then siphoned into the same jar as was used for the original test and the contents weighed. The difference in weight was calculated as per cent air. The density of the boiled sample was found to be fairly constant. After proving the density, without air, was constant the boiled sample was only taken a couple of times a week to check ourselves. This was very helpful, as now all we had to do to find the air in the headbox stock was to fill the jar as described, weigh, and use the standard headbox density to figure the per cent air. The same jar was used for all tests so that any variation in jar size was eliminated.

Because we could reproduce this test to very close limits, we assumed the test to be fairly accurate. This method is much easier and quicker than the pipet method and I feel that the results are just as valuable. Another advantage, it only requires simple equipment, which can be found around any mill.

J. Wayne Dappen (Technical Director, Marinette Paper Co., Inc., Fort Edward, N. Y.): Scott Paper Co. and its subsidiaries are manufacturers of tissue and towel products whose consumer acceptance depends to a large degree upon absorbency and softness. Therefore, in the mill we do very little refining in the true sense of the word but use our refining equipment primarily as disintegrators and blendors.

For this reason we use a mild refining action in our laboratory pulp evaluation procedures. The pulp evaluation procedures employed are all TAPPI Standard methods listed below:

1. Laboratory Processing of Pulp (T 225 sm-43). The kollergang method is employed and all pulps are refined to one interval of 4 revolutions per gram of pulp.
2. Standard handsheets are made using the British sheetmaking equipment (T 205 m-53).

3. Standard physical testing of handsheets is done according to TAPPI Standards (T 220 m-46).
4. Other routine pulp evaluation tests made are Canadian Standard freeness, brightness, dirt and shive counts, permanganate number and fiber classification.

With regard to pulp evaluation or control procedures which are not standard, I would like to mention several that we use which may be of some help to you:

Fiber Classification

A great deal of time could be spent on the subject of fiber classification but I will only mention briefly the methods employed in pulp evaluation and process control.

In pulp evaluation, a two-screen fractionation is made on a 5-gram oven-dry sample run for 10 min. at a 3 g.p.m. water flow in a Bauer-McNutt classifier. A 14–48 mesh screen combination is employed for long fiber pulps and a 28–48 mesh combination for short fiber pulps. The results are reported as per cent of sample retained on each screen.

In process control, a single screen fractionation is made in a similar manner as mentioned above. The results are used to follow the uniformity of furnish as well as to give guidance in changing your blends of pulps for attaining desired characteristics in the finished product.

Quick Brightness Method

This method was developed for control in our pulp bleaching operation and requires approximately 7 min. to perform.

A sample of slush stock containing approximately 3 grams of fiber is diluted to 1 liter with water and poured into a sheet mold which has the wire just covered with water. The mold is drained, the sheet couched off on clean blotters, and pressed between dry blotters for 30 sec. at 50 p.s.i. The wet sheet is removed and dried for $3^1/_2$ min. on a coarse mesh screen heated from above and below by a bank of infrared lamps. The brightness of the handsheet is then taken on a Photovolt. The results compare within 0.5 to 1.0 point of the TAPPI Standard method.

Quick Consistency Method

On long fiber slush stock a rapid consistency can be obtained by use of a basket centrifuge. A 500-gram sample of slush stock is weighed out, poured into a basket centrifuge containing a fine mesh screen, and centrifuged for 3 min. The wet cake is removed from the basket screen and weighed wet. By use of a predetermined dryness factor the consistency of the original sample can be calculated. In general, the dryness factor of the wet centri-cake will remain nearly constant on a given slush pulp but should be checked frequently.

This technique is employed satisfactorily in our bleach plants and the dryness factor is sufficiently uniform that the 1-gram sample of unbleached pulp for permanganate number tests is weighed from the wet centri-cake.

Because of the absorbency and softness factors, the desired physical characteristics in our products, in general, cannot be developed by refining but have to be fabricated in the initial furnish by a blend of pulps. Long fibered pulps for strength and to form the coarse lattice work in sheet structure; intermediate fiber length to fill the large voids and aid in appearance and formation, and short fiber to close the sheet and add bulk.

From our standpoint, the most desirable quality of any pulp, and I feel it comes first, is uniformity. If the pulp is over-all uniform from shipment to shipment or batch to batch, the paper machine can be adapted to run it with a minimum amount of trouble. Nonuniformity is the characteristic in all pulpmaking that causes the most trouble. How many of you have experienced difficulty with a new pulp supply that causes all kinds of trouble when first used in the furnish? Yet, you learned to use it by modification in blending and/or the paper machine. In a short time it changed from an undesirab desirable pulp in the eyes of the papermakers but it change as evaluated in the laboratory. This is possible the pulp is uniform in quality.

In closing I suggest that you evaluate your pulps an pliers, not always by which is higher in strength, tear ness, fraction, etc., but by which one consistently gives y highest quality and the best uniformity.

Empire State (Metropolitan District)

The March 9 meeting of the Metropolitan Distr TAPPI was held at Fraunces Tavern with an attendanc members and guests. After a brief discussion of April nations for office and proposed by-law amendments, Lewis of The Institute of Paper Chemistry spoke on the portance of Wood Utilization."

The general topic of discussion was the broadened us application of materials available in wood. Mr. pointed out the present and projected processes for utili of chemicals and fibrous materials now being discard waste or being used in very limited quantities. Such terials as bark, wood waste, sawdust, lignin compounds chemicals found in spent cooking liquors were considere methods of broadened utilization were discussed. The developments in high yield pulping and bleaching, both ical and mechanical, were presented. Future possib and process expansions were outlined and comparisons between utilization methods in Europe and Canada and presently used in the United States. On his recent t Scandinavia Mr. Lewis found forestry practice there w superior to the best practice in this country.

A chemical industry utilizing wood as a raw material f extraction of basic chemicals was considered. A comp of chemicals thus extracted was made with petroche and the parallel economics were examined. A num chemical materials such as alcohols, proteins, amino phenols, tannins, and lignin compounds were referred examples of materials available and presently being ob through suitable treatment of wood and spent cooking l used in pulping. Research efforts in this field were ou and the importance of continued active research was out.

A lively question and answer period followed the ma cussion. Specific problems relating to utilization an servation were discussed and individual applications described and appraised. The subject of stream pol and its partial elimination through broader utilizati papermaking wastes was also developed.

Lake States

An outstanding program was enjoyed by members Lake States Section of TAPPI at a meeting held on Mar 1954. In the afternoon the Wausau Paper Mills at Br Wis., was visited by about 160 members. Here the features such as a sulphite acid plant designed express producing ammonia-base acid, a beta gage for conti measurement of basis weight, and their newly complete ishing room.

The evening program was held at the Wausau C Wausau, Wis., with about 200 in attendance. Geo Brabender served as moderator for a forum on "t methods." The following subjects were discussed:

"Moisture Testing of Paper," by J. D. Line, Mosinee Pap
"Shortcomings in Testing Methods for Printing Paper Gary W. Jones, Consolidated Water Power & Paper C
"Strength Testing—Equipment and Methods," by Herb Rowe, Nekoosa-Edwards Paper Co.
"Testing Paper for Hygroexpansivity," by John T Marathon Corp.

S. R. Parsons, *Secre*

Moisture Testing of Paper

J. D. Line

THREE GENERAL HEADINGS

1. Laboratory sample testing as per TAPPI T412 –53. Gravimetric method.
2. Laboratory or production sample testing by means of various moisture meter testers.
3. Continuous testing and recording by use of various instruments on paper machines.

BRIEF DESCRIPTION OF METHODS

1. Conductivity of the paper.

A. The paper acting as a conductor is inserted in an electrical circuit.

B. The resistance of the paper changes considerably depending on its water content.

C. A source of constant voltage causes current to flow through the paper in such a way that changes of the conductivity of the paper cause variable currents which are recorded by a measuring instrument.

D. The flow of current is affected by other properties than water content, such as basis weight, porosity, surface smoothness, and chemicals used.

E. For different types of papers, reproducibility may vary as much as from 2 to 4%.

2. Dielectric constant of the paper.

A. In testing moisture in paper by the dielectric constant method, the paper acts as the dielectric medium of a capacitor.

B. The capacitor consisting of separate metal strips which form a plane.

C. The capacitor and its induction coil are fed by a high frequency generator.

D. The metal plates emit an RF-voltage which penetrates even very thick papers.

E. This method of moisture testing is not affected by all the properties which affect the conductivity method. However, it is affected by basis weight and the instrument should therefore be calibrated for the basis weight being tested.

3. Relative air humidity surrounding paper.

A. By the third method, the paper causes the surrounding air to be in a state of relative moisture.

B. A humidity meter placed close to the paper will register a change which is dependent on the water content of the paper.

C. Some moisture meters of this type place materials in the vicinity of the paper, such as viscose, the conductivity of which changes depending on the moisture content.

D. Some moisture meters employ a thin sheet of porous material inserted in a dielectric capacitor.

E. The change of the moisture content of this porous material is used to determine the moisture content of the paper.

F. Different types of paper vary in their conduct as to the creation of a certain relative moisture in the surrounding air in relation to their water content.

G. This method of moisture testing would therefore seem to be subject to, let us say, several difficulties.

Over a period of years, we at Mosinee have tried at least two methods of continuous measurement of moisture in the paper as it came off the dry end of one of our machines.

Neither our production department nor our quality control laboratory was very well satisfied with either method. This was principally due to not being able to keep the apparatus in working order for more than 50 to 60% of the time, and not being able to recalibrate or adjust fast enough to keep up with changes of grades on machine.

We have also experimented with several methods of moisture testing of paper in our quality control laboratory. The basic trouble with all methods tried was, first, the time consumed to obtain a reading and second, the lack of consistent reproducibility.

For the past several years, we have been using Hart moisture meters, Type K-101. We have two of these meters. Although we have not eliminated all our troubles by a long way, we have stopped the production department complaining about the order being made before the laboratory completed the moisture test.

As many of you perhaps know, the Hart moisture meter is of the conductivity type and consists essentially of three parts. First, a contactor, the area and pressure of which is kept accurately the same on all meters of the same type. Second, a series of fixed unchanging resistors, so chosen as to represent the resistance at various points over a wide range of moisture content percentages. Third, a very sensitive, yet extremely simple voltmeter with which to compare the reading obtained from the paper with the reading obtained from the various standard resistors.

The meters are quite easy to operate and a moisture reading can be obtained in not over two minutes' time. We have had very little, if any, trouble with the meters, except to change batteries when necessary. The main trouble is in the variation of the time and handling the samples from the time they are removed from machine reels until they are placed in the meters for testing.

We use a pneumatic tube system to send samples for test from all machines to laboratory. The samples are torn from reels, placed in cylindrical containers which, of course, are not absolutely air tight. Therefore, the difference between the moisture values obtained at machine reel and those obtained in the laboratory will vary depending on elapsed time, handling, air conditions, and type of paper. These are the troubles referred to at the beginning.

From time to time, we run check tests consisting of removing three samples from the same position of reel, placing one sample in sealed metal can, one in regular pneumatic tube container, and testing one direct at reel. On unsized free papers, we find the average differences in moisture values to be of the following order:

Hart reading at reel	4.10%
Hart reading in lab	5.50%
Hart reading at reel, sample cooled 1 min	6.1%
Gravimetric method	2.35%

Similar check tests on high sized flat papers showed the average difference in moisture values to be 1.5 to 2.0%. That

H. W. Rowe, Nekoosa-Edwards Paper Co.; John Teeple and G. J. Brabender, Marathon Corp.; J. D. Line, Mosinee Paper Co.; and G. W. Jones, Consolidated Water Power & Paper Co.

J. D. LINE, Mosinee Paper Co., Mosinee, Wis.

is, the Hart laboratory values average 1.75% higher than the values obtained by the gravimetric method of test.

Check tests have also been conducted on a slab consisting of as many as 30 sheets of the paper slabbed from the reel. These slab samples were placed in the pneumatic tube cylinder and sent to laboratory for test. By using two Hart meters and testing each sheet from both top and bottom of slab and plotting readings, we obtained a fairly uniform concave curve. The values for top and bottom sheets of slab represented the ends of curve while the value from the protected center sheet represented the low point of curve. The difference between the two points we found to average from 0.50 to 1.50% depending on grades of paper being tested.

We realize our present method of moisture testing paper is far from being ideal. However, it suits our conditions better than any method we have tried to date. That does not mean we are satisfied, for we are not, and no doubt many of you are not satisfied, so how about having some discussion of moisture testing of paper from various points of view, from superintendents to scientists.

Shortcomings in Testing Methods for Printing Papers

Gary W. Jones

This discussion is divided into two parts since a good printing paper must possess two basic qualities, namely: it must handle well mechanically, and it must be characterized by good printability. Each of these requirements is rather nebulous and is a function of a number of properties of the sheet. Let us consider each one individually, examine as best we can its nature, and see how we attempt to evaluate it in the laboratory.

Considering the paper first from the standpoint of mechanical performance; if it is sheeted stock, a primary requisite is that it lie flat and remain flat during the entire printing operation—this may mean anywhere from one to as many as six passes through the press. If at any time the sheet tends to curl, we run into difficulties due to faulty feeding and jogging and to wrinkling. If the surface of the sheet is too slippery, then too we may find it difficult to feed the press. Strength is probably not of primary importance in the printing operation itself. However, the paper generally must meet strength specifications which are dictated by the end use of the printed sheet.

If curl tendency—or rather lack of it—is so critical, then certainly we must make every effort to evaluate it in the laboratory before shipping the sheeted stock out. What means do we have for such an evaluation? Let us consult our Bible, TAPPI Standards. We find something over 80 methods listed for testing paper. Only *one* test deals with the problem of curl, and this involves wetting one side of the sheet and noting the amount of curl which develops. Actually it is more of a size test than a curl test. Furthermore, toward the end of the method, it is frankly admitted that the test by no means will predict the curl tendency of the paper under all conditions.

With the exception of offset printing, the usual conditions that cause paper to curl during the printing process are dry conditions rather than moist. Thus the TAPPI test seems to be of questionable value.

Our laboratory has developed a test which involves drying out a strip of paper and measuring the curl tendency. It seems to be more in the proper direction than the TAPPI test, but we do not feel that we can predict at all accurately whether or not a run of paper is going to curl in the press. In view of the importance of curl, it would seem that our lack of a suitable means of evaluation is a serious shortcoming.

If the paper is shipped out in rolls and printed in web form, strength assumes a role of utmost importance. Th must be pulled off the reel, yanked over this and that, d through a myriad of rollers, and sometimes even drie crisp between gas flames. If it snaps at any point in th ess, we really have a mess—down time on the press, ba printing plates, etc. Generally, if it breaks more than eight times per hundred rolls printed, the printer will b complain bitterly.

What do the TAPPI Standard methods have to of evaluating the strength of a web of paper which must stand this sort of treatment. It can be fairly well summ with the familiar burst, tear, tensile, and stretch tests. might expect the tensile test to be the most satisfactory the web of paper is subjected primarily to a tensile stress being pulled through the press. Actually, and perha first thought, strangely, our experience indicates that r tensile nor bursting strength (which is closely related) pr a satisfactory evaluation of the expected mechanical pe ance of a paper web on the printing press. Although parently is not fully satisfactory, the tearing resistance paper seems to be the best test that TAPPI Standards h offer.

It is interesting to speculate as to just what kind of we might need in order to evaluate this quality of mech performance on the press. If we consider a roll of pa in. wide which has a TAPPI tensile strength of 10 lb., v calculate that the total pull that the web should be a withstand is something over $^1/_2$ ton. Probably the why, in practice, the web will not withstand stresses considerably less than this figure is that the stresses t concentrate at various points across the web. It is at points that rupture will occur. However, it is conce that if the paper has sufficient give to it, there will be a ency to relieve the stress points without breaking the thus equalizing the tensile stress across the entire we might seem, than, that the type of test we need should of stretchability, not under the almost static conditions conventional tensile test, but rather under highly dy conditions where the sheet is suddenly yanked as it is printing press. I understand that the Dutch have co with a so-called dynamic tensile tester which in effect strip of paper and measures the work done in causing ru It can be expected that the more give or stretch that th possesses, the greater will be the distance over which th turing force will operate and hence the greater will amount of work done. Perhaps this test will be more factory than the tear test for predicting mechanica formance on the press. Let us hope so, because at the p time this particular property, important as it is, does n pear to be evaluated properly.

Let us now turn to the second basic attribute of a printing paper; namely, printability. What is it and h we evaluate it? Although I am concerned with it every day, I would hesitate to formulate my own defini printability. Therefore I shall quote the definition wh given in the APPA "Dictionary of Paper." Accord this authority, printability is: "That property of a which printed matter of good quality in any printing tion. The property at present is not accurately defined judged by uniformity of color of the printed areas, co between printed and clear areas, legibility of the printe ter, and show-through. It is generally believed tha property is related to ink receptivity and its uniformity pressibility, smoothness, and opacity."

I could quote other definitions, but they wouldn much; they are all quite vague and in effect point out t the present time printability cannot be defined in a manner. The definition which I quoted is probably one best I have seen in that it at least brings out certain attr of paper which are in some manner related to printa Let us consider these properties in more detail:

Gary W. Jones, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

1. *Compressibility*—This property is especially important in letterpress printing. The sheet must possess sufficient resilience or cushion to compensate for irregularities in the printing plate or in the surface of the paper itself.

2. *Smoothness*—This property is relatively easy to define but rather difficult to measure. A perfectly smooth sheet would have an absolutely plane surface contour. Good smoothness is required if the printed image is to show fine detail. It is important in letterpress printing and particularly so with respect to rotogravure.

3. *Ink Receptivity*—This property is important to all types of printing. It is difficult to define and even more so to measure. First of all, the ink must wet the surface of the sheet, and then it must be absorbed to the extent that good bonding will occur between the ink and the paper. Too much absorbency will result in a dull, muddy impression; also, strike-through may result.

4. *Opacity*—This might be defined as the resistance presented by a sheet to show-through of dark objects which are in contact with the back side of the sheet. The reason for its importance in printing papers is obvious. It is significant to point out that the show-through of a printed image is a function not only of the intrinsic opacity of the sheet but also of its absorbency. A sheet can be fundamentally quite opaque, but a printed image may show through badly if the ink vehicle penetrates the sheet too deeply.

To these four properties we should add a fifth; namely, surface strength or resistance to pick. If particles of the sheet tend to pick out and adhere to the printing plate (or the blanket in the case of offset printing), the printing job will generally be ruined completely. It is highly important, therefore, that the sheet have adequate surface strength to resist picking. This property is particularly important in offset papers.

We have defined and discussed rather briefly what printability is, and now the question arises as to how we evaluate it in the laboratory. Again let us refer to TAPPI Standards and see what tests are offered. We find seven tests which might be related in some manner to printability. Among these tests compressibility or resilience is not included. Two of the tests are concerned with gloss, a property that I have not as yet mentioned because I do not feel that it bears a particularly fundamental relationship to printability. This is my personal opinion, of course, and I realize that there is plenty of room for argument. In any event, gloss refers to the glare of the surface and is generally measured as the spectral reflectivity of light at some given angle of incidence and reflectance. It is an excellent test for controlling degree of finish, but probably that's about all. It is not uncommon to find a sheet that possesses a high degree of gloss but which will not print at all satisfactorily.

TAPPI Standards do include a method for evaluating smoothness. As a matter of fact, the method consists of three different methods; that is, three different instruments are suggested for measuring smoothness. Furthermore, it is stated that the three instruments do not correlate well, and as a result, whenever a smoothness test is reported it is necessary to specify what type of instrument was used for the evaluation. This situation in itself implies that we have not yet developed a satisfactory method for evaluating this important property.

Two methods will be found in TAPPI Standards which pertain to ink receptivity of paper. One is an air permeability test, sometimes referred to as the density or porosity test. Although it must bear some relationship to ink receptivity, such relationship is probably rather distant. The other method, sometimes called the castor oil penetration test, more closely simulates actual use conditions and is rather satisfactory, I understand, for many uncoated papers; however it falls short when applied to coated stock. Another test, which is not included in TAPPI Standards but which is frequently applied to coated papers, is the so-called K & N test. To perform this test we smear a special ink on the sheet, wipe it off after a specified time interval, and then measure the brightness of the inked spot and compare it with the brightness of the original surface. The test is often helpful in evaluating absorptivity, but the results are difficult to state in a concise, intelligible fashion.

One test that seems to be fairly satisfactory is the one for opacity. Probably the reason for this is that it is a relatively simple matter to simulate in the laboratory the use conditions of the paper. I am quite confident that we can measure opacity and tell the customer that the paper is or is not satisfactory from that standpoint. Of course, when it comes to poor opacity due to excessive absorptivity and resultant strike-through, that's a different matter entirely and we are talking about a completely different paper quality.

Finally we come to the subject of surface strength. To measure this property TAPPI Standards offer the time-worn wax pick test. I believe that it is the general feeling of manufacturers of printing papers that this test is not fully satisfactory, primarily because it does not simulate conditions which prevail on the printing press. However, there have been some recent developments in measuring pick resistance which I believe are going to be quite helpful. I am thinking particularly of the LTF pick tester which apparently simulates press conditions quite closely.

In view of the apparent difficulty that exists in evaluating printing papers, it might seem quite remarkable that manufacturers are able to turn out huge tonnages daily of paper that completely satisfies the printers. What is the secret? The answer is quite simple; we print it ourselves before shipping it out. The laboratory of virtually every large manufacturer of printing papers is equipped with at least one proof press, and it is generally customary to make a trial print on every reel manufactured. It is a practical system that seems to work out very well, and the chances are that the proof presses will be with us for some time yet. This test has its shortcomings, however, in that it serves little more than to tell us whether or not a sheet will print satisfactorily. It does not offer much in the way of why a sheet prints well or why it does not. More and better fundamental methods of evaluation will be necessary before we can learn all we want to know concerning the requirements of a good printing sheet.

Perhaps it might be inferred from my remarks that my purpose has been to belittle the progress that has been made thus far in evaluating printing papers. That is not the case at all. It is quite evident that the problem is a highly complex one, and that tremendous strides have been made already. It is also evident that there remain frontiers to conquer. If I have made this one point clear and if I have tended to dispel some of the complacency that is inherent in most all of us, then I will feel that my efforts have been well worth while.

Paper Strength Testing—Equipment and Methods

Herbert W. Rowe

Regardless of its surface properties, optical properties, and visual attributes, a paper must be strong enough to meet the end-use requirements. I think we will all agree on that simple statement. However, the agreement would not be so complete were we to choose a grade of paper and attempt to establish the minimum strength properties required of that paper and the best way to test those properties.

To stimulate discussion, I should like to explain how we handle a couple of the common strength tests at Nepco, namely, bursting strength and internal tearing strength. I

Herbert W. Rowe, Nekoosa-Edwards Paper Co., Port Edwards. Wis.

don't expect you to agree with me completely. After all, the TAPPI method for bursting strength (T 403 m) was adopted as an Official Standard in 1926, then was demoted to a revised tentative standard in 1952 after 26 years of use.

A great deal of time must be spent in calibrating and checking paper testing instruments. An equal amount of care has to be exercised in their use. The reason for this is rather obvious. All paper tests that I can think of, with the possible exception of basis weight, are empirical. They are reproducible and of some meaning only as long as all the "rules of the game" are followed implicity.

The two tests that I want to discuss for a few minutes defy reduction to a simply physical formula. Take bursting strength. First there is a stretching of the paper by a protruding rubber diaphragm whose contour changes as it expands. This is followed by rupture which apparently is a tensile failure, but certainly not a straight line tensile pull.

The Elmendorf tear test attempts to measure the force required to break some fibers and drag others past adjacent fibers in continuing an initial cut or tear for a distance of 1.69 in.

In paper testing we do not make direct physical tests, as might be done in the manufacture of, for example, a stove bolt. I have never tested stove bolts, but I would guess they could be readily tested for diameter by means of go-no go gages, for length, for pitch of the threads, for shear, etc., and even for composition to second decimal precision, all regardless of the relative humidity of the testing station.

Such is not our lot in paper testing! However, with increasing sales of specification papers, paper testing becomes more important and it is up to us to guarantee manufacturing and sales that the paper they have produced and sold as being up to standard by our tests will still meet standards when tested properly in any other good laboratory.

At Nekoosa-Edwards, as in many other paper mills, we test bursting strength with a B. F. Perkins Model C Mullen Tester, using Prestone as the hydraulic fluid. A standard rubber diaphragm and a 0 to 120-lb. gage are used on all papers except lightweight tissues. These papers are tested on an instrument equipped with a dental rubber diaphragm and a 0 to 30-lb. gage.

Gages are tested weekly, and oftener if results are in question, by means of an Ashcroft deadweight tester. Each instrument is checked whenever there is doubt by means of aluminum foil of the proper bursting range purchased from the Pulp & Paper Research Institute of Canada. (I see that such foil is now available from Testing Foil Service in Rhinelander.)

Diaphragms are tested for extensibility by means of a $^3/_8$-in. bridge gage.

Maintenance of these testers is directed by a man who spends full time on instrument maintenance. In addition, we have one of the older paper testers spend a day per week in each mill checking paper testing instruments. Simple maintenance is also performed by the testers on the job.

The chief maintenance item on Mullen testers is removal of air from the hydraulic system. This air can usually be detected by the sound of the pop—a loud pop indicates air in the system. Whether the amount of air present is excessive can be determined by means of the standard TAPPI procedure, using a rigid metal plate and manual rotation of the pump. However, I believe the August, 1953, revision of T 403 must be in error in stating that the pump is to be rotated by hand until a pressure is "just registered on the gage." Carson and Worthington describe (*Tappi*, Dec., 1952) this check for air and definitely state that the test for air is to be made at the midpoint of the gage range. We check the prescribed limits at the midpoint of the gage, but cannot check at the extreme low end.

Diaphragms are replaced at least once per week and whenever air is removed from the tester. At the same tim Bourdon tubes of the gages are bled.

Clamps are adjusted to prevent slippage, yet to be e operate.

No particular skill is required in making a burst test– I can do it! All the operator has to do is make sure th specimen is clamped without wrinkles and that the s does not slip during testing.

Our sample consists of a strip approximately 6 in across the machine. Five tests are made from the wir and five from the felt side, starting about 6 in. from each Before testing, the sample is conditioned for at least 1(at 50% R.H. and 73°F.

Bursting strength is reported as the average of the 10 We think we are doing a pretty fair job on testing bu strength. However, it is sometimes hard to convince a mer who is making Mullen tests with an old hand-o tester in a nonconditioned atmosphere that his tests are n valid. Harder yet is the job of convincing a machine that a sudden drop in the Mullen test was the result of making and not paper testing. These are the peopl keep us on our toes in paper testing.

For tearing strength we use the standard Elmendor tester made by Thwing.

This instrument is checked for zero load before eac because paper dust can easily get on the bearing. If th point does not check per TAPPI Standard T 414 m, we the level and adjust pointer friction.

At least once per week, each tester is calibrated with 2 55, 75, and 90-gram weights purchased from Thwing. instrument does not check with these weights, the bea cleaned. If the bearing is too worn to check after cle the instrument is shipped to the factory for repairs.

The length of slit (20 mm.) is also checked with a gag chased from Thwing.

Maintenance of the tear tester is fairly simple, consist cleaning the bearing, applying petrolatum, and wiping excess with a soft cloth. However, as mentioned b paper dust can throw off the tear test at any time and for pointer friction must be quite frequent.

For tearing strength we use a strip taken clear acr machine and folded to give an equal number of felt an sides facing out. We made a minor study of this proc on butchers paper versus all felt side out and all wire si and didn't find much difference. However, I suspect might be some difference with MG papers. Perhaps so you can give us this information.

All of our samples are conditioned for at least 10 min. testing for tear. As you know, the tearing strength is more dependent on moisture content than is the bu strength.

A bit more skill is required for the tear test as com with the burst test. Samples must be cut square and paying particular attention to the grain direction. C required in seeing that samples are solidly placed in the to give the proper length of initial cut. Samples shou even with the jaw edge on the front or swinging side. Sa protruding beyond the jaw on this side will give higher r due to air resistance.

For routine testing we use a strip about 5 in. long a it protrude on the back side. However, for more acc tests, on pulp handsheets for example, we do not let the ple protrude on the back side. Samples that extend b the clamp on the back side seem to give us slightly h results than if the test is made strictly according to T procedure.

We also deviate a little from TAPPI Standard in tha paper testers give a very slight bend to the samples slitting and before releasing the sector. This proc seems to give us a better straight line tear and more cons results.

We tear enough sheets to give a reading between 20 and 40 on the scale. Our testers catch the swinging sector just after it starts to descend from the peak of the oscillation. Care must be taken not to jar the pointer in this operation.

For routine tests, we make two tears in each direction on the sample which has been folded to give a rough composite across the web, and report the average tear in each direction.

With all our precautions, we still run into the problem of determining whether a sudden change in tear or other physical properties of paper with change in shifts is due to the change of paper testers or the change of machine tenders. Perhaps you have the same problem.

I have spent probably more time than I should on the details of testing paper for bursting strength and tearing strength. However, these are typical of our attempt to follow TAPPI procedures as closely as possible *except* for those little variations that creep into our testing procedures and probably into many of yours. If we have "done wrong," we would like to be told so in the discussion period.

Lake Erie

The March 19 meeting of the Lake Erie Section of the Technical Association of the Pulp and Paper Industry featured a paper by Charles A. Markee of the Ohio Boxboard Co., entitled "Chemicals as Aids to the Papermaker and Converter." Mr. Markee's talk follows:

Chemicals as Aids to the Papermaker and Converter

Charles A. Markee

THE title which has been assigned for this discussion is apt to be somewhat misleading to one not familiar with our industry. It implies that chemicals are used to supplement the processes of manufacture and conversion of paper and that their use is dictated by the special requirements of the end product. Actually, this is only partly true. Certain chemicals are basic in the paper and paperboard manufacturing process and without them the pulp and paper industry could not have expanded to its present position as the fifth largest industry in the United States. However there are other chemicals, not strictly necessary for paper manufacture, which can be used as definite aids to the papermaker and converter.

It is not my intention to enumerate this rather extensive list of chemicals or go into any detailed description of their application in the manufacturing process. What I would like to do is mention a few of these chemicals with which I have had some experience and show you some examples of their effect on the finished product.

Papermaking chemicals other than fiber in the form of virgin pulp or waste paper which are added as a routine thing in the stock preparation stage are rosin size, sodium aluminate and alum for water resistance and pH control. For example, take an unsized piece of blotting paper and a sheet of sized bond paper. It will be noted one feathers when ink is applied, the other does not. Harder sized sheets may be obtained with larger amounts of sizing agent for food board, milk bottle stock, beer carriers, and map paper, using waxes, asphalt emulsions, and wet-strength resins.

You have all seen on your television sets the ads by the Scott Paper Co. for their new Scotties with wet strength and have seen their demonstration which is a good example of the property these resins can impart. Additional chemical additives are chlorine, chlorphenols, mercurials for slime control, foam killers, pitch dispersants, defibering aids, wetting agents, detergents for cleaning, etc.

Fiber alone sometimes presents printability problems. The addition of mineral fillers to the furnish in the form of titanium dioxide, clay, diatomaceous earth, and various precipitated pigments such as carbonate, calcium sulphate, and silicate aid the papermaker and converter materially by increasing ink receptivity, opacity, and brightness.

Starches added to the furnish supplement the natural adhesives present in the cellulose fiber. Improved fiber to fiber bond means greater strength, better finish or smoothness, and freedom from fiber picking when the surface is later printed. Starches may be added raw to the beater, they may be first swollen and gelatinized by cooking, or they may be purchased as pregelatinized starches which have been already cooked and dried.

Another class of additives which has been receiving considerable attention are the mannogalactan gums. This group includes the locust bean gums and the guar gums either used alone or extended with starches. These gums in proper concentration have the ability to deflocculate fibers and consequently are being used for formation and bursting strength improvement. I'm sure we can all see what a tremendous aid this type of additive could be to the papermaker in enabling him to produce a higher strength sheet at possibly lighter basis weight with increased machine speed.

The additives we have mentioned so far aid the papermaker primarily through improving the operation of the system and help him produce a quality sheet with minimum machine difficulty.

It is oftentimes impossible or economically impractical to build the desired properties into the sheet prior to the time it is formed on the paper machine. Certain chemicals applied either at the size press, coating station, calender stack, or in an additional converting operation can impart properties which will greatly aid the final converting process.

I think most of us consider one of the first steps in the converting process to be the printing operation. With the many varied types of printing operations and customer requirement, it is rare to be able to utilize board or paper directly from the paper machine without first subjecting it to some type of chemical treatment. This chemical treatment may consist in improving the finish of the board by applying a solution of a thin-boiling starch to lay down the fibers and enable the calender stacks to do an efficient job of smoothing. However, if the printing operation requires the use of gloss inks, then this type of treatment is not sufficient to produce a satisfactory degree of gloss. This appearance may range from a low gloss, or dull film, to a high shiny appearing ink film and the treatment must be chosen with respect to this desired effect. There are a number of materials in use in different mills to accomplish this. These include various types of starches, carboxymethyl cellulose, alginates, and polyvinyl

C. A. Markee, Ohio Boxboard Co.

CHARLES A. MARKEE, Ohio Boxboard Co., Rittman, Ohio.

alcohol. The concentration of solution and amount of application are controlled to give the needed effect.

From top sized sheets to coated sheets is just a step and here, too, certain chemicals can be utilized to aid the converter in turning out a quality product. Coatings are applied for a number of reasons. They may be intended to improve the printing surface of the sheet or to impart special properties for particular uses. Coatings such as polyethylene and the vinyls can impart grease resistance and moisture vapor resistance to the sheet as well as improving the appearance. These same coatings over printing can impart gloss and scuff resistance to the board that may be impossible to obtain by other means. Materials such as greaseproof paper and backed films of foil, cellulose, polyvinylidine can be laminated to paper and paperboard using dextrines or microcrystalline wax for various special packaging protection.

With the increased use of containers for display purposes, decorative coatings on liners have become an important part of the corrugated field. Chemicals such as clay, dyestuffs, starch, casein, the various latices, alkalis, deflocculants, and lubricants all play their part. He also has chemicals such as formaldehyde and metallic salts, to insolubilize the coating to obtain good wet rub characteristics. The list of chemicals which will aid the coating man is as extensive as that which the papermaker has at his command.

The list of chemicals which can aid the papermaker and converter is never complete as new developments are being made at too fast a pace. For example, fire retardants are in demand for such things as match cover stock and wall board. Silicone coatings are being developed to take advantage of the release properties of the silicones for such things as candy wrappers. Another fairly recent development is the utilization of certain chemicals that act as vapor phase inhibitors. Board coated with these chemicals is in great demand for packaging metal parts to protect against corrosion.

New England

The March meeting of the New England Section was held at the Hotel Bond, Hartford, Conn., on March 19. During the afternoon about 70 took advantage of the invitations to visit the mills of Colonial Board Co., Lydall & Foulds Paper Co., Inc., and Rogers Corp.

At 4 p.m. a technical session was held which featured papers by John D. Hinchen of the Monsanto Chemical Co. and H. E. Orford and H. Heukelekian of Rutgers University.

After dinner, which 75 attended, a movie, "How to Make a Better Impression," was shown through the courtesy of the Harris-Seybold Co.

R. W. Ramsdell, *Secretary*

Some Quick and Easy Statistical Methods

John D. Hinchen

Many people have a tendency to shy away from the more mathematical statistical procedures like analysis of variance, correlation analysis, and even from such things as tests for significance. The reason sometimes given is the amount of mathematical skill involved and the need for expert computers to carry out the details of these analyses. While I do not necessarily conform to this viewpoint, it remains a fact that quite often data adaptable to statistical analysis are frequently interpreted "by guess and by golly," because of the time involved in carrying out the proper statistical interpretation.

It is not always realized that there exist many rapid statistical methods, adapted from the more rigid techniques, some of which require only that the operator know how to and read numbers. These techniques are based on mathematical principles, and can often be used to ob quick answer which gives the user at the same time a bility figure against which he can judge the correctness decision made. I would like to discuss a few of these may be applicable to some of the problems facing those who are interested in investigating the factors affecting pr quality in the paper industry.

In the manufacture of a type of paper, the amount c used in the formula lends certain characteristics to the fi product. In addition, the usage of clay in excess may some adverse effects on the quality of the finished pr One phase of the investigational work is concerned with mining the effects of clay content on the quality of the fi product. The standard method for approaching the pr might be to manufacture a series of runs in the plant, an the clay content from run to run over the range which be considered practical from past experience. Then sa of the finished paper will be taken and various test The results of these tests are then compared with the am of clay in the formulation, and the decision as to the amount to use will result. Ordinarily, when a ful statistical program exists, the technique of correlation an is used. However, this is a somewhat complex metho if five or six properties are involved the required calcu time may be out of line. If we can weed out the factor are not affected we might concentrate our calculating ti the others.

A RAPID CORNER TEST FOR ASSOCIATION

Wilcoxon (*1*) discusses a procedure which might give answer we are seeking. He calls it the quadrant sum for association, and it is a quick method of telling wheth can say that two things are related, with a certain proba of being correct in so stating. Supposing our experim data look something like this:

Formulation clay content, lb.	*Finished product* — *Fold*	*Opacity*
100	30	75
125	28	73
150	23	74
175	26	77
200	21	76
225	22	77
250	20	80
275	15	75
300	17	81
325	14	80

Step I. Our first step is to plot a scatter diagram for set of data. In the first, we plot the fold test values a the corresponding clay contents, in the second the o test results are so plotted:

Step II. Taking the first diagram, we divide the data four quadrants by drawing first a horizontal line throug data, so that the same number of points lie above the zontal line as lie below. Then we draw a vertical li that the same number of points lie to the left of the line to the right. The upper right and lower left quadran called plus (+) quadrants, because if a positive relatio exists, the line showing that relationship would pass n through these quadrants. The upper left and lower quadrants are called minus (−) quadrants, since an i or negative relationship would show most of the points in these two quadrants.

Step III. Starting at the right side of the diagram, a straight edge on the paper, parallel to the vertica drawn through the data. Moving the straight edge vertical) to the left, we count the number of successive

John D. Hinchen, Quality Supervisor, Monsanto Chemical Co.

on one side of the horizontal line, stopping when we find our first point on the other side of the line. In the fold test data, we find four points in the minus quadrant, and then one in the plus quadrant. Write down −4. Then starting from the bottom with the ruler parallel to the horizontal axis, we move upward, counting four in the minus quadrant before any plus values are found. We write down another −4. Similarly we come in from the left side, counting −4 again. Then, coming down from the top we count another −4. We then add all these results together and find that they total −16.

Mr. Wilcoxon has published a table showing the quadrant sum values that we might expect to get due to chance by this operation, if in fact no relationship exists. A portion of this table is as follows:

Significance level	*Quadrant sum*
10%	± 9
5%	±11
2%	±13
1%	±14

The value obtained above was −16. This is greater in magnitude than the value opposite 1% significance in the table. This means that the probability of obtaining this value from unrelated variables is less than 1%, so that we may say, with 99% confidence that there is a real relationship between clay content and fold test.

Following this procedure through for the opacity test, we obtain a quadrant sum of +10, which according to our table has a probability of between 5 and 10% of occurring due to chance if there is in fact no relationship. We may still wish to accept this as a strong indication that the relationship exists.

Wilcoxon goes on to point out what procedure to follow for odd numbers of points, and in cases where several values fall on the lines dividing the quadrants. Reference to his work and the sources quoted is recommended.

THE SIGN TEST

One of the questions facing the quality control man in any industry is whether his inspectors are evaluating the quality of finished product with the same degree of severity. It is the custom in some plants to send through samples from time to time which are graded by various inspectors, and the results compared to see whether a difference exists between inspectors. If there is a large difference, it is almost immediately obvious, and the proper additional training may be initiated. Sometimes, however, a small but consistent difference exists, and it may take many such comparisons to bring it out. A handy test to use for making these comparisons is known as the sign test, described fully as to background and usages by Dixon and Massey (*2*). An example of the application of this test to the problem of inspector agreement follows. Two inspectors have graded over a period of time, the same samples, obtaining results as shown.

. S. Klein, Chairman, New England TAPPI, Byron Weston Co., Dalton, Mass.; John D. Hinchen, Quality Supervisor, Monsanto Chemical Co., speaker

Sign Test

Lot	*Inspector A*	*Inspector B*	*Sign A-B*
1	6.4	5.2	+
2	1.7	1.9	−
3	1.1	0.5	+
4	1.3	0.7	+
5	2.6	2.5	+
6	2.4	2.2	+
7	0.3	0.7	−
8	4.2	4.1	+
9	3.7	2.5	+
10	1.1	1.0	+
11	1.2	1.7	−
12	2.2	2.0	+
13	2.5	2.0	+
14	0.6	0.5	+
15	1.1	0.9	+

In comparing these results lot by lot we note in the last column whether the result obtained by inspector A is larger or smaller than that obtained by inspector B. If A is larger we write a plus sign, if B is larger we write a minus sign. Then we add up all the plus signs and all the minus signs and compare the smaller number to the following table:

5% Critical Values for the Sign Test

N =	10	15	20
Critical value	1	3	5

If the number of plus or minus values is equal to or less than the critical values, we may say with 95% confidence that a real difference exists between the inspectors. In our case, $N = 15$, the number of minus signs is 3, so that we make the decision that the inspectors do differ in grading severity. A review of the grading standards with these inspectors is in order.

RANK CORRELATION

Another question that may arise is "Do these inspectors generally obtain similar results on a given lot?" In other words, once we know that a difference between inspectors exists, we are interested in finding out whether they both grade the poorer lots as poor, and the better lots as good. We could approach this problem by using the quadrant sum method, but another technique exists which might be of interest. This is known as rank correlation, and is explained at some length by Dixon and Massey (*2*).

Let us take the data on the individual lots, and rank them for each inspector in ascending order of magnitude. For inspector A, lot 7 is the lowest, so we call that 1, lot 14 is next, so we call that 2 and so on to lot 1, which we call 15. Similarly for inspector B, except where 2 or more lots have the same value. In that case we average the ranking that they would have been given, had they been slightly different. For example, inspector B found lots 14 and 3 to be the same. These are the lowest, and would have been assigned ranks 1 and 2. The average of 1 and 2 is 1.5, so we assign the rank of 1.5 to each. The next lot then would be ranked 3, and so on. We then find the difference between rankings for each lot, square these differences, sum the squares and substitute the

value obtained in the formula given. The result is compared to the table of critical values, and the decision made that a real relationship exists. The calculations for this method follow:

Rank Correlation

Lot	*Inspector A*	*Inspector B*	*Difference*	d^2
1	15	15	0	0
2	8	8	0	0
3	4	1.5	2.5	6.25
4	7	3.5	3.5	12.25
5	12	12.5	−0.5	0.25
6	10	11	−1.0	1.00
7	1	3.5	−2.5	6.25
8	14	14	0	0
9	13	12.5	0.5	0.25
10	4	6	−2.0	4.00
11	6	7	−1.0	1.00
12	9	9.5	−0.5	0.25
13	11	9.5	1.5	2.25
14	2	1.5	0.5	0.25
15	4	5	−1.0	1.00
				35.00

$$\text{Rank correlation coefficient} = 1 - \frac{6\epsilon d^2}{N(N^2-1)} = 1 - \frac{6(35)}{15(224)} = 1 - \frac{210}{3360} = 1 - 0.06 = 0.94$$

Critical values, %: 5—1.000; 10—0.746; 15—0.623; 20—0.534.

In any discussion of abbreviated statistical techniques, there are several points which must be considered. Both Wilcoxon, and Dixon and Massey discuss these points thoroughly, and I would recommend study of these texts before attempting to use any of the techniques outlined in this discussion. Some of the major points to be remembered are:

1. These methods are "stacked" for safety, and as such are less sensitive than the standard methods.
2. Conversely, a significant relationship or difference shown by these methods is practically certain to be significant by the standard techniques.
3. All these techniques are based on sound statistical principles, and it would be advisable to study their background to obtain a better understanding of their usage.
4. This point is general for all tests for significance. When a comparison of data fails to show up as significant, we do not make the conclusion that no difference or relationship exists. We merely suspend judgment and say that the data do not indicate the existence of the difference or relationship. In applying this reasoning to these quick methods, we might wish to apply a more sensitive test before dropping the experiment.

There are many other quick and easy statistical methods which may be applied to experimental or routine operating data. The two sources which I have quoted probably cover the more widely recognized techniques in some detail. The use of these methods with the necessary precautions should go a long way toward developing more widespread acceptance of the statistical viewpoint in industry.

LITERATURE CITED

1. Wilcoxon, Frank, "Some Rapid Approximate Statistical Procedures," Stamford Research Laboratories of the American Cyanamid Co.
2. Dixon, W. J., and Massey, F. J., "Introduction to Statistical Analysis," McGraw-Hill 1951.

Biological Oxidation—Friend or Foe?

H. E. Orford and H. Heukelekian

Biological oxidation may be defined in the broadest sense as the utilization of matter as food by living organisms in which the oxygen transformation serves as the main source of energy. Thus our own living process is really one of bio-

H. E. Orford and H. Heukelekian, Rutgers University, New Brunswick, N. J.

R. W. Ramsdell, Hercules Powder Co.; Freeman H Chemical Paper Mfg. Co.; R. T. Bingham, TAPPI; Klein, Byron Weston Co.; John D. Hinchen, Mon Chemical Co.; Gordon Benson, St. Regis Paper Mrs. G. Benson, Miss Ann M. Brown, Hercules P Co.; Jack Fife Wright, Natl. Aniline Div.

logical oxidation. The biological oxidation with whi are concerned right now is one which is accomplished by organisms in water and wastes. Bacteria, protozoa, and finally some of the larger forms of microorganism the most important. Before we can understand biol oxidation it is first necessary to consider the three c interrelated factors which affect or control biological tion, namely, food, organisms, and environment.

FOOD

The chemical composition and physical state of subdi affect the availability of the food. Some organic ma are more readily available than others: sugars are readily available than lignins, although both are compo carbon, hydrogen, and oxygen. In general, as the comp of the organic substances increases, the availability dec

The physical state of subdivision of the food affe availability and the rate of oxidation. Since microorgan obtain their food by a process of diffusion through th membrane, it follows that only diffusible and soluble ma are readily available. Nondiffusible and coarse pa must be converted into soluble materials by exoe enzymes by a process of hydrolysis before they can into the cells and be absorbed. Hence, in wastes cont both soluble and insoluble organic materials, the for oxidized first, whereas the oxidation of the insoluble fr is controlled by the rate at which it is hydrolyzed. It f that wastes containing only insoluble particles will be ox at a slower rate than wastes containing only soluble mat

In general, the rate of oxidation is independent of the tity of organic material (food) present, but when strong are treated the rate of oxidation may be affected by ciency of the oxygen supplied.

The carbon-nitrogen ratio of the organic material affects rate of availability. Investigations have show one part of nitrogen is required for every 20 parts B.C the waste to allow oxidation to proceed rapidly.

Phosphorus is essential also for cell nutrition and oxi of organic material. About 1 part of phosphorus for e to 100 parts of B.O.D. is required.

ORGANISMS

Complex organic materials cannot be oxidized in t sence of microorganisms. Plain aeration in the abse organisms may result in some coalescence of finely d material and chemical oxidation of reduced substances as sulphides, but no biochemical oxidation. In gener greater the numbers of organisms present the shorter th required for oxidation. However, there is a relationsh tween the number of organisms and the food supply.

means that excessive numbers of organisms are of little value if a limited food supply (low concentration of impurities) is present. The oxidation may be accomplished by aggregations of organisms (such as activated sludge floc or trickling filter slimes) or by bacteria in a dispersed state.

The oxidation of complex organic materials present in sewage or industrial wastes is not carried on expeditiously by a single type of organism. Hence, treatment of industrial wastes by pure cultures of organisms, even though feasible, would not be an efficient process. (There is no comparison between waste oxidation and industrial fermentation or antibiotics production because in the processes using a single type of organism only a specific material is produced, leaving the bulk of the original organic material unoxidized.) Two types of bacteria working in association are better than one type alone because one of them may utilize the products of the other and carry the oxidation process further. As the number of types of bacteria increase, the efficiency increases. The introduction of protozoa into wastes containing a great number and different types of bacteria increases the rate of oxidation. This leads to the concept of a biological community or association chain of different living organisms. The types of organisms within this living chain vary with the type of waste and the environmental conditions, and a single type of organism may be preponderant in a specific type of waste. Those that fit into a particular chain of reactions and form a necessary link with the preceding or succeeding reactions will survive and predominate, whereas others will be eliminated or reduced in numbers.

The preceding discussion on the effect of types and numbers on oxidation is based upon the premise that a process has been developed and has been in progress in which a successful adaptation or acclimatization of flora and fauna, originally present in the waste or after its artificial introduction, has taken place. If the diversified flora and fauna are lacking, it may be necessary to introduce a "seeding" material, such as domestic sewage or soil suspensions, which contain the diversified organisms.

Acclimatization or adaptation may be brought about by neutral selection where certain species in the mixed population and the conditions and food best suited for their development and eventually become the predominant forms or it may be brought about by "training" where certain species when subjected to unfavorable conditions, such as toxic materials, may be made to tolerate eventually a higher concentration of toxic substances. Certain varieties in the species of organisms may be more resistant than others, or they may be trained to withstand a higher amount of toxic materials by gradually increasing the concentration.

It is important to bear in mind that such a process of acclimatization, adaptation, training, selection, and mutation has definite limits. It is not possible to treat wastes containing high concentrations of toxic materials, no matter how assiduously attempted. There is an upper concentration of poison that can be tolerated and the maximum concentration that can be tolerated depends on the specific compound. It is also affected by the type and concentration of the nontoxic organic matter present in the waste.

ENVIRONMENTAL CONDITIONS

The effects of pH values and temperature are well known. The oxidation rates of wastes between pH values 6 and 8 are not materially affected. Frequently, there is a tendency for the pH value of an acid waste to rise and of an alkaline waste to decrease as a result of treatment by an oxidation process. The natural compensation may be utilized before pH correction is attempted. Mineral acids are not utilized by bacteria under aerobic conditions. Since one of the end products of complete oxidation is carbon dioxide, this gas may affect the pH value considerably, especially in poorly buffered wastes. The temperature coefficients during deoxygenation of diluted wastes have been carefully worked out. In general, higher temperatures (within limits) speed up the rate of oxidation.

The presence of an ample supply of oxygen is essential for oxidation. Theoretically, maintenance of a trace of oxygen is sufficient, but industrial wastes with a high oxygen demand require the maintenance of a higher dissolved oxygen level to increase the rate of oxygen diffusion.

OXIDATION DEVICES

In general, oxidation devices may be divided into two groups, namely, those utilizing flocculent growths and those utilizing nonflocculent growths. In the first group belong activated sludge, low-rate trickling filters, and high-rate filters. In the second category may be included sand filters and the aeration with dispersed growths. The difference between these two groups of treatment devices consists mainly in the relative quantities of sludge produced. In the first group the purification and oxidation occur in flocculent masses of growth, whereas in the second the oxidation is accomplished by dispersed bacterial cells.

There are only a few compounds which microorganisms cannot attack and utilize as food. The rate at which these materials are attacked and utilized depends on the nature of the compound, the organisms, and the environmental conditions. Some food materials are more readily available than others. The availability of the food materials is determined primarily by its chemical composition, but a knowledge of the chemical composition is not sufficient for the prediction of its availability. Also, availability is not related to the energy level of a compound. For instance, sugar, cellulose and lignin are all compounds of carbon, hydrogen, and oxygen. They have practically the same energy values, but their availability is greatly different. Sugar is readily available, cellulose less available, and lignin practically unavailable as a source of food for microorganisms. The problem is not necessarily one of particle size even though sugar is in solution while cellulose is a larger size molecule and exists only in suspension of various sizes. This does not explain the difference between cellulose and lignin. For a given material, however, the smaller the state of subdivision the greater is the availability. We are immediately confronted with the mechanisms whereby microorganisms are capable of utilizing the food materials. All food materials must enter the cell through protoplasmic membrane before they can be utilized within the cell. Food materials must, therefore, be in solution before they can diffuse through the cell membrane. Those wastes in which the organic materials are already in solution can be utilized immediately and directly. Wastes containing suspended matter cannot diffuse through the cell until they are hydrolyzed by enzymes excreted by the microorganisms that convert the wastes into soluble forms. There is a great number of hydrolyzing enzymes produced by microorganisms specific for various types of organic materials capable to convert them into their specific soluble forms. For instance, cellulose is hydrolyzed by cellulase into cellobiose, the disaccharide, which in turn is hydrolyzed by cellulase into glucose. It might be expected that the necessity of preliminary hydrolysis of larger particles would decrease the rate of utilization of these materials and that the larger the size of a particle the longer it will take for it to be decomposed. This is not, however, universally true. There are instances where the rate of hydrolysis is greater than the rate of assimilation of the hydrolysis products by the microorganisms, e.g., the rate controlling factor is not hydrolysis but the assimilation.

The enzymes secreted by the cell become diluted in the surrounding substrate thereby slowing down the rate of hydrolysis. The products of hydrolysis in turn are dispersed throughout the substrate and the diffusion into the cell and consequent utilization is retarded. It will be found in

such cases that the attachment of the bacteria to the suspended particles, as in the case of cellulose fibers, greatly accelerates both hydrolysis and assimilation phases.

Only after the soluble food materials diffuse through the cell membrane, the process of assimilation really starts. For instance, a molecule of sugar is dissimilated through a complicated series of steps liberating energy and producing the final building blocks which are then synthesized into cellular materials of the same type as the original compound entering the cell or entirely different compounds. Only a portion of the energy liberated from the intracellular breakdown of the compound diffusing into the cell is actually utilized in the synthetic stage of metabolism. The rest is either dissipated as heat or a part of the energy value of the original compound may appear in the intermediate products due to the incomplete breakdown. Under aerobic conditions, the breakdown of food materials is practically complete and there are no energy values left in the end products. Complete destruction of wholly available food materials, even under strictly aerobic conditions, is an impossibility. Some organic material remains as a residue in the form of microbial growth. When the food is not completely available, there are additional amounts of residual organic materials left in the substrate.

AVAILABILITY OF BACTERIAL FOOD

Even a completely available material may not be utilized by microorganisms if certain elements that are required are absent or deficient. For instance, a pure solution of sugar in distilled water is decomposed at a very slow rate by microorganisms. This is due to the fact that sugar contains only carbon, hydrogen, and oxygen, and microbial cell constituents consists of in addition to these elements, nitrogen, phosphorus, sulphur, and a number of other elements in smaller quantities. Nitrogen and phosphorus are the essential protoplasmic constituents, a deficiency of which will limit growth. The carbon, nitrogen, and phosphorus ratio of the food materials or the waste are, therefore, important considerations in establishing optimum conditions for biological treatment processes of wastes in which the ratio is too wide. In terms of biochemical oxygen demand, it has been found that for every 100 parts of 5-day B.O.D., 5 parts of nitrogen and 1 part of phosphorus should be present in the waste or be added artificially to the waste in case of deficiency to bring up the ratio to these values.

The numbers and types of organisms constitute the second set of important factors in conjunction with the type and quantity of food that determine the rate of biological activity. When the suitable environmental conditions are created and maintained for a given type of waste, the necessary flora and fauna establish themselves provided that the waste is not devoid of these organisms and further, provided that there are no toxic materials present in the waste to prevent their development. When even a few of the proper organisms are absent in a waste, then it becomes necessary to introduce them by artificial inoculation from a suitable source, such as sewage or materials collected from a sewage treatment plant. It may be digested sludge or activated sludge for the respective type treatment of the waste. When the toxic concentration of a waste exceeds the tolerance limits of microorganisms, sometimes dilution of the waste may overcome the difficulty. Otherwise the exclusion of the particular toxic compound should be resorted to. Attempts to add a mixed artificial culture of microorganisms have not proved to be valuable despite many claims made.

Thus far we have had a very superficial and general discussion of the first part of the title, namely, "biological oxidation," and we have not mentioned anything about the second part of the title—"Friend or Foe."

Biological oxidation is usually good and sometimes bad. Moreover, I think that we must all agree that biological oxidation is a real friend since biological life on this earth, know it, would be impossible without oxidation.

We ourselves are complex organisms wholly dependen biological oxidation for our life processes. Of course, w been discussing microbiological oxidation, but even th would be impossible without this form of life. Microorg eventually oxidize all of the dead plant and animal ma into mineral matter consisting chiefly of carbon dioxi nitrates. This mineral matter is used in turn by living animals, and microorganisms to synthesize new organ terial which will eventually go around the life cycle ag

Of course, it might be possible to have some sort cycle which could operate with only anaerobic microbic decomposition of organic material, but I am sure th would be far different from its present form. Life to us hardly be very pleasant if the products of all biologi included hydrogen sulphide, mercaptans, butyric acid, skatols, and other odoriferous compounds.

Microbiological life makes possible the treatment wastes, the natural purification of streams, and many phenomena which are of great benefit. Truly then m ological oxidation is a great blessing.

If we consider biological oxidation in a narrow sen at times these blessings are not so apparent. In the industry, slime problems are very troublesome, and I not have to tell you that. Sliming, however, is the re biological oxidation. In fact, one of the common ev of biological oxidation is the growth of slimes.

Streams undergo self-purification through biological tion, but this results in a reduction of the oxygen le the deoxygenation is rapid enough, the oxygen is all u anaerobic conditions take over, hydrogen sulphide an noxious gases are formed, and our medium becomes a s mess. Thus, uncontrolled biological oxidation can cause the conditions which we try to prevent.

An important secret of waste treatment is the co biological oxidation. This can be done by controlli concentration or controlling the environment. With control biological oxidation is of course a great blessi

Paper of the Journal Series, New Jersey Agricultural Experiment Rutgers University, the State University of New Jersey, Depart Sanitation, New Brunswick, N. J.

Southeastern

The fourth meeting of the program year of the South Section of TAPPI was held at the George Washington Jacksonville, Fla., on March 19, 1954. The largest in the history of the Southeastern Section, about 230 tered for the meeting.

The program activities got under way with a meetin Executive Committee at 4:00 p.m. The social hou sored by St. Regis Paper Co., Jacksonville, was held p.m. Dinner was at 7:00 p.m.

Mr. Pineo, Section chairman, presided over the session with Mr. Rogers, vice-chairman, in charge program.

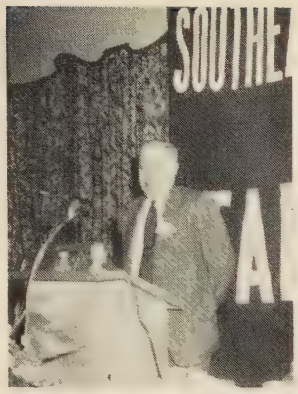
Mr. Ferguson, resident manager of the St. Regis J ville mill, welcomed the group on behalf of the host m

At the conclusion of the program, Mr. Ferguson di the St. Regis plant here. He extended a cordial in to all to visit the mill Saturday morning. Over 140 themselves of this opportunity. Some were heard to that it was a "spotless" mill.

R. G. Macdonald, Secretary-Treasurer of the Te Association of the Pulp and Paper Industry, was pres made a few brief comments. We are always glad t officials of the National Organization meet with us.

Three prepared papers were presented during the e

ohn K. Ferguson, St. Regis Paper Co.



R. G. Macdonald, Technical Association of the Pulp and Paper Industry

addition, R. H. Renko of Diamond Power Specialty Corp. ve an informal talk on "Television in Industry."

A description of several television installations was pre- nted by Mr. Renko with the use of slides. Application for ewing smoke stacks or boiler gages in power plants, furnaces steel mills, and filling hoppers in cement plants was illus- ated.

Each installation required study of the conditions at the int of application. Selection of the particular location for mera and power unit was emphasized. For particular con- tions, protective housing for the camera had to be provided. hanges in weather conditions or high dust concentration uld require such housing. Where installation space is ited, special traversing and elevating mechanisms may be quired. It is very seldom, however, that more than the sic television units are needed.

Since 1946 over 200 installations have been made or are on to be completed. Most of these applications require ly limited attention after working many hundreds of hours. he units are far less complex than commercial television its.

A typical installation of equipment was provided at the eeting for inspection. Camera and power unit were in eration.

R. M. Taft of Factory Insurance Association pre- ted a paper "Fire Protection in Pulp and Paper Mills." is paper was prepared by R. C. Max of the same company *Tappi* 37, No. 2: 65–72 (Feb., 1954)).

Mr. Max pointed out most pulp and paper mills have been, the past years, and still are dependent upon their own re- ources for establishing their defenses against fire, since most ills are not located within the city limits, due to their size nd other factors such as availability of timber, etc. He also ointed out that many of the original mills were constructed incipally of wood, but in recent years most plants are now steel and concrete construction.

He stated that the most progressive and safety conscious ills immediately took advantage of the automatic sprinkler rotective systems. He touched briefly upon the construc- on of mills, such as the necessity of fire walls, arranging of torage areas, proper handling of combustible materials, and ypes of equipment and safeguards necessary. Sprinkler eads now in use were described, citing their advantages and isadvantages. It was pointed out that he knew of no ecord where a drier was ever damaged by a sprinkler system oing off. Several comments were made on the usage of ammable materials, the gathering of fiber dust, the oil haz- rds, and the highly inflammable chemicals used in many lants and made a note of the different types of fire fighting quipment needed in such areas where these hazards were und.

The protection of elevated chip bins is of prime concern due the fact that the highest B.t.u. heat concentration is lo- cated here. Chip bins should be constructed of incombustible materials and protected by adequate sprinkling systems.

Mr. Max stated that many people thought that a tight roll of paper would not burn, but disproved this fact and stated that in all cases paper storage areas should be covered with proper roofing materials and should definitely be covered with automatic sprinklers.

Mr. Max then discussed at some length methods used in bleaching plants and boiler houses, referring to the type of fuels used by various installations and the safeguards used at such installations. He stated that recovery furnaces used in sulphate mills presented probably the most hazardous operations, so far as fire and explosions were concerned. He also gave a very good account of necessary precautions to be taken in printing and coating areas. He next talked along the lines of pulpwood yards, giving some case histories of fires in some of the northern wood yards. He stated that no wood piles should be over 45 ft. high with a distance of 50 ft. between piles or an equivalent of 2500 cords per pile. Mr. Max stated that statistics indicated that more fires are started by electrical causes than any other, and spoke on the effectiveness of a good maintenance and inspection program.

Mr. Max stated that all fire records hinge from the organization of an employee fire brigade emphasizing the fact that as fire brigades perform, so is reflected the fire records of any company. He did state, also, that the most appalling fire loss in American history was caused by welding and cutting operations. He pointed out the fact that the practicing of good housekeeping and keeping up a good maintenance program, connected with the instilling of a fire consciousness at all plant levels were of utmost importance.

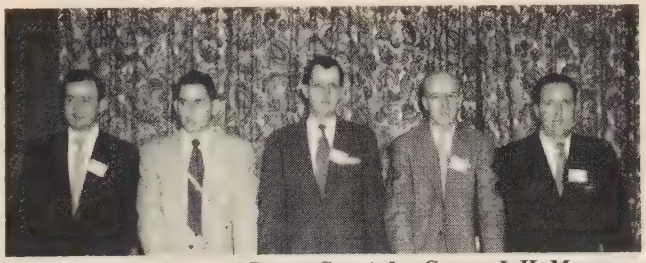
J. H. Mappus, Jr., of West Virginia Pulp & Paper Co., Charleston, S. C., presented a 10-min. paper on "The Saline Dilution Method of Liquid Flow Measurements."

Apparatus required is modest. A lightning mixer is mounted on an open 55-gal. drum to dissolve the salt and agitate the solution. A small centrifugal pump, also mounted on the drum, is used to force the solution into the stream.

F. W. O'Neil, New York State College of Forestry, Syracuse, N. Y., presented the principal paper, "Chemigroundwood—Your Hardwood Mechanical Pulp."

The most important points covered in Mr. O'Neil's paper were summarized by R. H. Stevens, of Herty Foundation, as follows:

1. Any wood may be used.
2. Liquor composition, temperature, and time have to be varied according to the wood and results desired.
3. Higher temperature increases chemical action reducing yield producing stronger pulp but of lower brightness.
4. In grinding the semicooked bolts the stones can operate longer between dressings (400 hr. versus 16 for raw wood).
5. The liquor composition most used is a 6:1 ratio of Na_2SO_3:-$NaHCO_3$ both calculated as soda ash. Concentration equals 0.75 to 1.5 lb. per gal. total.
6. The temperature range is usually from 130 to 140°C. and hydrostatic pressure 150 p.s.i.g., time on temperature 6 hr. This is preceded by an evacuation period of $^1/_2$ hr. at 28 to 30 in. vacuum.



R. H. Renko, Diamond Power Specialty Corp.; J. H. Mappus, Jr., West Virginia Pulp & Paper Co.; R. M. Taft, Factory Insurance Assn.; F. W. O'Neil, New York State College of Forestry; John K. Ferguson, St. Regis Paper Co.

7. At the end of the cooking period the liquor is blown out to a storage tank where it is fortified by addition of chemicals to previous concentration and re-used. At the Forestry College they have re-used liquor up to 75 times. Great Northern, at Millinocket, Me., have re-used the same liquor for 8 months. No recovery operation is used. Thickener effluent goes to waste.

Photomicrograph slides were shown which illustrated the character of the fibers. The contrast between "raw" groundwood and Chemigroundwood was plainly evident. The latter approached the character of chemical pulp fibers.

The effect of the liquor on the wood bolts could be demonstrated, the speaker said, by the knife test. Holding aloft his pocket penknife he said it was impossible to force the point of this more than $^1/_4$ in. into the uncooked wood. After the cooking treatment it could readily be pushed to the full length of the blade with even less pressure.

The logs take up approximately 100% of their weight of liquor. This is then lost in the wash water

One of the slides gave comparative data from fiber classifications. The "debris" (through 100-mesh sieve) had been reduced by 50%.

Some hybrid poplars grown on the College forest plantings, at 6 in. DBH, gave a pulp of 67 brightness when cooked at 140°C., but lower for higher temperatures. Ash and oak had been used also, but "the oak does not cooperate too readily." This species is being investigated further. The optimum has not yet been reached.

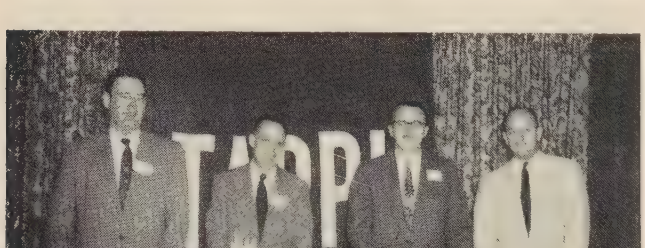
Just recently experiments have been made with southern pine. The results are very interesting. The fiber behaves on the fourdrinier like redwood bark fiber. At the couch it resembles a felt blanket. It should make a good insulating board. They were able to get a 0.40 burst factor and 1.0 tear factor.

In working with aspen they ran into something very interesting. There would be occasional areas of dried out wood which gave only brittle fibers. This wood gave off acetic acid and had low pentosan content (by hydrolysis to furfural). Photomicrographs indicated this wood had crosswalls resembling the tyloses of oak. Slides were exhibited showing tangential sections of this wood and also of normal wood. These showed the crosswall structure very clearly. Further research disclosed these brittle portions contained fusarium yeast cells.

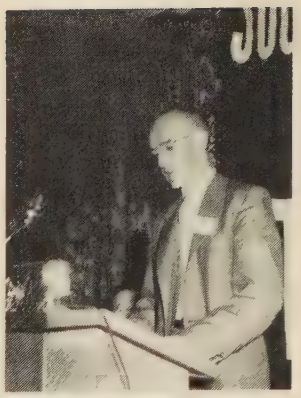
A research study in Minnesota had found the aspen has become infected with a bacteria. It develops this is now widespread from Maine to Minnesota and throughout the Lake States region.

Chemigroundwood pulp responds to peroxide bleaching in identically the same manner as spruce groundwood. Also it can be bleached with hypochlorite. If unbuffered, however, the pH drops rapidly. Lime helps prevent this. Other bases also; sodium silicate produced a 27-point gain in brightness with 107% yield. Washing lowered the brightness and brought the yield back to normal. The silicate had reacted with the bleach liquor to form calcium silicate which is retained as a filler adding to yield and brightness *provided* the pH does not drop below 7.0.

Summing up Mr. O'Neil listed the advantages of Chemigroundwood process:



Charles Rogers, Sonoco Products Co.; Malcolm Pineo, Brunswick Pulp & Paper Co.; Glen Kimble, Union Bag & Paper Corp.; and K. M. Guest, National Container Corp.



F. W. O'Neil, New York State College of Forestry

J. H. Mappus, Jr., Virginia Pulp & Pap

1. Higher strength, compared to "raw" groundwood.
2. Double or triple the production rate..
3. One-half the power requirement (30 to 35 hp.-da ton versus 65 for "raw" groundwood).
4. Cost $39.70 (chemicals, wood, process).
5. Use of higher density wood which means more p cord.
6. Bleachability similar to chemical pulps.
7. Can be used in newsprint.

At Millinocket, Me., using 54 by 62-in. stones, 150 they get 50 tons per day per stone from aspen versus "raw" spruce. With 17% chemical pulp they m production with 55% better finish and better opac normal operating speed—1400 f.p.m. They are exp their facilities putting in two more "digesters" (40-ft. l 9-ft. diam. pressure tanks into which wood is run on c in creosote treatment).

The Saline Dilution Method of Liquid Flow Measurem

J. H. Mappus, Jr.

THE basic principle of liquid flow measurem the dilution method is simple. A salt solution of kno centration is pumped at a measured rate into a strea the flow of the stream is calculated from the change i centration.

The principle may be considered analogous to the of syrup and carbonated water to make a fountai Cola. By the strength of the "Coke" one is able whether too little or too much water was used. In the the dilution method from the strength of the mixture able to determine the proportion of dilution water and the flow rate.

Right here the author wishes to disclaim any orig for the idea. It is mentioned briefly in the Chemical E Bible "Perry's Handbook" and he is sure a literature would show numerous applications. Just recentl method was mentioned in a washing system test whe was used as the measured constituent.

Because the method has many virtues—it is simple tical, reliable, versatile, and economical—and because been used so successfully at our mill, I am presenti method to you with some of the techniques for possible use of your own.

Figure 1 shows the apparatus for the measurement by the dilution method. To you of the conventional this is a far cry from the orifices, venturis, positive di ment meters, or rotameters which are usually associate flow measurements. However, I assure you it is an a tus for accurately measuring flow.

. H. MAPPUS, JR., West Virginia Pulp & Paper Co., Charleston, S.

In this apparatus there is the ubiquitous 55-gal. drum which used as a mixing tank and reservoir for the salt solution. econd, there is a Lightnin' Mixer which is used to agitate e solution and reduce the dissolving time. Third there is a all centrifugal pump of 4 to 10 g.p.m. capacity for pump- g the salt solution into the stream. There is a by-pass line the pump outlet which can be used to further agitate the lution, and a pressure gage which offers an indication of the eadiness of the flow. Finally there is a yardstick attached a float from which the liquid level in the tank may be de- mined.

In addition to the apparatus, two taps are necessary in e line to be measured: one for the admission of the saline lution, and the other for removal of samples of the mixture. A mention of the location of taps might be in order here. fficient distance must be kept between the inlet and out- tap to allow for thorough mixing. In our tests taps were ually placed on the suction and discharge side of a pump. here this was not feasible, they were usually placed two ings apart—that is, two elbows or an elbow and a valve tween taps. Improper mixing will probably give trouble ly in cases of laminar flow.

To make a flow measurement, about 15 lb. of rock salt is solved in water in the drum. Rock salt is used because it cheap, will not contaminate the system, and the chloride terminations can be made in the low concentration range. is, by the way, accounts for the name "the saline dilution ethod."

After the salt has completely dissolved, a sample of the t solution is taken, as well as a sample of the liquid from e stream being measured.

The solution is then pumped into the flowing stream at a easured constant rate. To make sure the flow is constant, nearly so, measurements of the drum level are taken at 1- n. intervals. During the test about 10 samples of the mixture are taken at equal intervals. A number of samples is deemed necessary to make sure the flow rate is not fluctuating and to insure representative samples. I might add that after a little experience it was found necessary to analyze only half the samples. The test can be completed in 5 to 10 min.

ig. 1. Mixing assembly for saline dilution method of liquid flow

Upon completion of the test, the raw water sample, the saline solution sample, and the 10 mixture samples have to be analyzed for chloride content.

For the chloride determination, the sample is titrated with silver nitrate using potassium chromate as the indicator.

After the chloride concentrations have been determined, the flow rate may be calculated from material balances over the flows and chlorides. This can be reduced to one simple formula.

By this formula the flow of water (or the liquid being measured) equals the flow of the saline solution times the concentration of the saline solution less the concentration of the mixture all divided by the concentration of the mixture less the concentration of the original liquid.

And that is all there is to the saline dilution method of liquid flow measurement.

At the beginning of my talk, I made several claims for the dilution method of measurement. It is simple, practical, reliable, versatile, and economical.

As can be seen from the foregoing the method is simple. Once the equipment is assembled it is merely a matter of dissolving salt in water, and running several chloride determinations to measure a flow. Two men can obtain a flow measurement in less than an hour. Using the dilution method it was possible to measure all the raw water lines at our mill in two 8-hr. days, a total of 20 lines scattered all over the mill.

The method is practical: the dilution method of measurement involves no down time to the water system and no interruptions of service. Taps can be installed at very little expense and left in place. (Usually existing taps can be found.) The use of a rubber hose makes connecting into the line no problem.

The method is reliable: prior to the extended use of the dilution method we checked the method out in a line which contained two meters, a positive displacement type and an orifice

In duplicate runs using different concentrations of chloride the dilution method checked itself within 5 g.p.m. in 450 g.p.m. and was within 10 g.p.m. of the positive displacement type meter and 30 g.p.m. of the orifice. While this is not conclusive proof, it is offered as an indication of the method's reliability.

The method has been found to be very versatile. Flow measurements ranging from 200 to 4000 g.p.m. have been made at our mill on raw water lines. By the adjustment of the flow rate and concentration of the saline solution considerably higher flows may be measured.

Measurements have also been made on many diverse liquids, for example, black liquor, lime mud, 4% stock, and machine room white water. In addition the method has found use in such locations as the suction boxes on the fourdrinier machines and the evaporator condensate lines.

The method is economical: the major expense in this method is the initial outlay for the mixer and pump, a cost of about $250. Additional expenses are for the fittings. Considering the versatility of the apparatus and the use of the equipment for other purposes, it is felt that this expense is easily justified.

Naturally, the method has some drawbacks. It is not adaptable to fluctuating flows. It is not a type of measuring apparatus that can easily be made indicating or recording, and it requires laboratory facilities to obtain the necessary data. However, as a method for measuring a variety of liquid flows over a wide flow range under unusual conditions it is highly recommended.

The Control of Pests of Green Lumber and Pulpwood with Benzene Hexachloride

RICHARD C. BACK and MARSHALL SITTIG

INSECTS attack trees at all stages of their existence, from seed to maturity; the ravages of pine bark beetles and spruce budworms are well known. Then after cutting, trees are still subject to damage when they are in the form of felled logs and green lumber. Seasoned timber in use is subject to still further attack from termites and wood borers.

Damage to felled logs and green lumber and its effective prevention constitute the subject of this article. Felled logs are generally destined for one of two commercial end uses: pulpwood for paper manufacture or as lumber for construction purposes. In pulpwood, the insects not only cause a direct loss of wood fiber, but are largely responsible for the introduction of fungi which cause an even more serious loss through stain and decay. Figure 1 shows actual wood loss in a pulpwood pile resulting from attack by borers. In commercial lumber, insects may riddle the wood with holes and near the holes may introduce stains. The combination of boring and staining causes serious losses to barrel stock, balsa wood for marine life rafts, and to valuable lumber for veneer to be used in houses, boats, or airplanes.

The following paragraphs give a brief introduction to the insects involved.

Round-headed borers (*Cerambycidae*), also known as longhorn beetles and sawyers, are large insects (see Fig. 2) whose larvae reach a length of $1^1/_2$ to 2 in. These pests cause considerable wood loss as well as introducing fungi into both sapwood and heartwood.

Flat-headed borers (*Buprestidae*), also known as metallic wood borers are very similar to the round-headed borers in appearance and activity.

Bark beetles or engraver beetles (*Scolytidae*) are only about $^1/_2$ in. long. They are found in all lumber areas and restrict their activities to the cambium region, where the adults form egg galleries and the larvae cause radiating tunnels during their feeding period. Actual wood losses from bark beetles, as from the other pests discussed here, are relatively slight but they do introduce fungi which stain and rot the wood.

Ambrosia beetles (*Scolytidae*, *Platypodidae*), like bark beetles, are only about $^1/_4$ in. long. The adults tunnel sapwood and heartwood, their damage leading to names such as shot-hole or pin-hole borers. Ambrosia beetles do not feed on the wood but, rather, on fungi which grow in the galleries which they excavate.

Repeated tests, made by several agencies since 1948, have consistently shown that benzene hydrochloride is the most effective single chemical for controlling these insects. Figure 3 shows the results of benzene hexachloride treatment. Note the smooth, clean appearance of the treated log as contrasted with the rough, stained appearance of the logs not treated. Many other insecticides have been tried, including aldrin, dieldrin, DDT, chlordane, heptachlor, endrin, isodrin, and toxaphene. Recommendations for benzene hexachloride have been based on emulsions and oil solutions formulated from technical (12 to 15 gamma) products. Higher gamma materials (36 to 80 gamma) may find use in emulsion concentrates. Tests have been carried out in Florida, Louisiana, Mississippi, Texas, and Wisconsin and are now under way in still other states. Experiments in southeastern states have included red gum and loblolly, slash, and longleaf pines; jack pine has been tested extensively in Wisconsin, and studies on aspen are in progress.

RICHARD C. BACK and MARSHALL SITTIG, Ethyl Corp., 100 Park Ave., New York, N. Y.

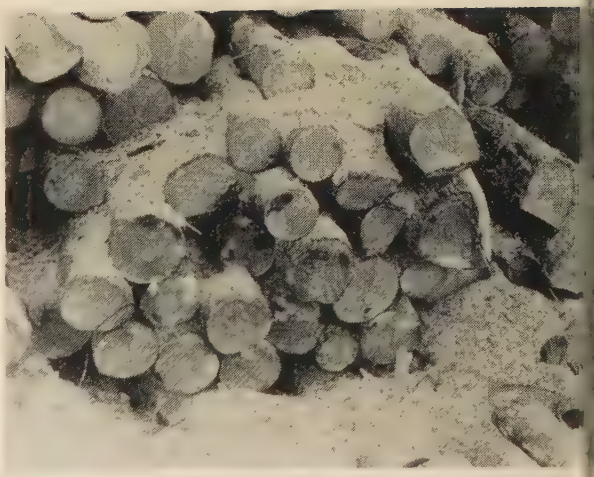


Fig. 1

FORMULATION

Oil solutions may be prepared from commercially
able oil-soluble benzene hexachloride concentrates or
rect solution of benzene hexachloride in no. 2 fuel oil.
are somewhat more effective than aqueous sprays b
more expensive and are sometimes objected to on th
of flammability. The actual gamma concentration
solutions is normally 0.5% or 1.75 lb. of actual gamm
zene hexachloride per 50 gal. of oil. Table I summari
amounts of various grades of technical benzene hexac
which are necessary to make solutions of this concenti

Emulsions can be prepared from commercially av
concentrates or from concentrates readily prepared
user. Emulsions are somewhat less expensive th
solutions and are suitable for both dips and sprays.
do not give quite as good contact and residual insect
as oil solutions, but their use involves no fire hazard
following steps are involved in the preparation of em
from technical grades of benzene hexachloride:

1. The benzene hexachloride is dissolved in the re
amount of solvent (3.75 lb. of 36-gamma benzene hexa
or 1.67 lb. of 80-gamma benzene hexachloride per gal. of be
2. Emulsifier is added to make an emulsifiable con
stock solution. (One-half pint of Triton X-155 or 1 pt. of
X-100 per $1^1/_2$ gal. of above solvent are amounts of typical
which may be used.)
3. The stock solution is diluted with water for applica
logs by spraying or dipping. An actual gamma-benzen
chloride content of 0.5% is customary for spraying and
tained by diluting 6 qt. of stock solution to 50 gal. For
dipping, a gamma-benzene hexachloride concentration o
is recommended and is attained by diluting $2^1/_2$ pt. of stoc
tion to 50 gal.

Fig. 2

The DRAPER Felt
DRAPER BROTHERS COMPANY
CANTON, MASS.

Table I

Gamma content of benzene hexachloride used	*Technical benzene hexachloride required per 50 gal. of oil, lb.*
10	17
12	14
15	11.5
36	4.7
80	2.1

Wettable powders are also commercially available from formulators of benzene hexachloride. These wettable powders may be mixed with water to give spray solutions.

APPLICATION

The best insect control on logs is obtained if they are sprayed within 48 hr. after cutting. Single logs and stumps may be sprayed with a knapsack sprayer. A more economical procedure for large stacks of pulpwood involves spraying with high-pressure equipment developing 200 to 400 p.s.i. In either case, special attention should be given to the butt ends of the logs and spraying must be completed before insects have infested the logs (see Fig. 4). Both oil solutions and emulsions have been used in spray applications to logs.

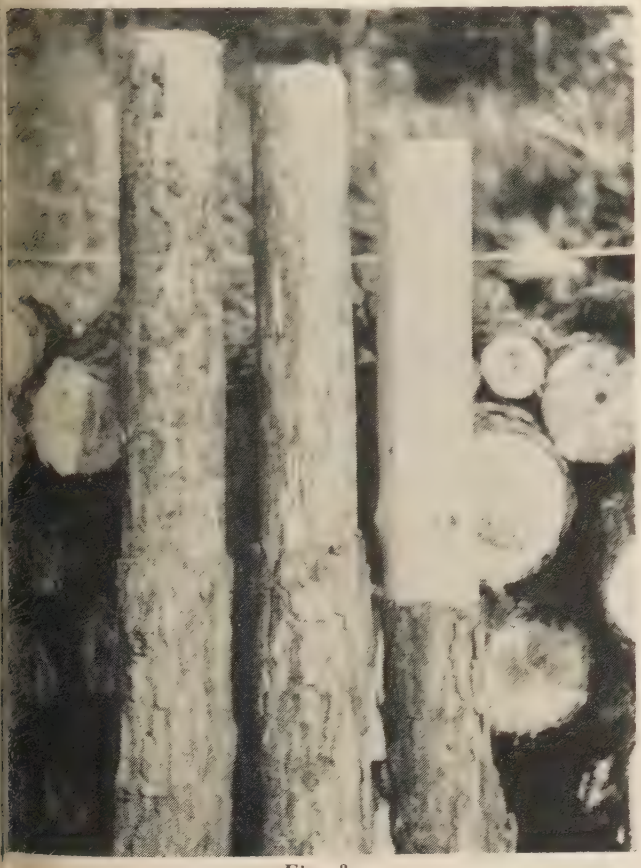


Fig. 3

Fig. 4

For green lumber treatment, emulsions and wettable powder formulations are recommended for spray application. Emulsified benzene hexachloride has also been applied successfully in dipping vats and is compatible with the fungicides commonly used in dips for the prevention of sap stain.

The formulations suggested above are applied at the rate of 1-gal. per 100 sq. ft. or 2 to 5 gal. per cord.

CONCLUSIONS

Benzene hexachloride, applied as an oil solution or emulsion in spray form is an effective agent for the control of ambrosia beetles, bark beetles, and wood borers on pulpwood providing protection for 3 to 4 months or longer depending on the climate. Similarly, benzene hexachloride can be used in emulsion or wettable powder formulations as sprays or dips for the control of these insects on green lumber. In either case, actual wood loss is reduced, fungus damage is reduced, and downgrading of the resultant wood and paper products by insect damage is avoided.

Received Oct. 14, 1953.

A Quality "Efficiency" Rating for Paper Mill Production

R. A. BUTLER and T. D. SYME

It is generally standard practice in paper mills to express efficiency of the paper machine operation in terms of a production efficiency figure which is obtained by dividing the actual production by the possible and stating the result as a percentage. One significant shortcoming in using the production efficiency alone as a measuring stick is that in no way is the very important factor of product quality taken into account. In other words, although tonnage from the machine may be considered satisfactory for shipment and thus be credited to production, such factors as sheet appearance, roll condition, and physical tests might possibly be improved to make an over-all superior product. It is also true that mills do find it necessary to divert tonnage because of quality reasons and such action in no way penalizes the production efficiency figure unless the paper is returned to the beaters.

The interrelationship of production and quality has been a subject for discussion by the Crown Zellerbach Corp. technical supervisors group for some time with the specific focus of attention centering around methods by which quality might be given more equal emphasis as compared to production efficiency, particularly during periods of increased production demands. It was agreed that it would be a step in the right direction if a method for measuring quality and arriving at a single descriptive figure were introduced into the operation of a paper mill. Such a figure would in fact indicate the quality "efficiency" of the operation and would take an important place alongside production efficiency values in placing before personnel concerned, from the operators and supervisors to the management and executive groups, the over-all picture of the paper machine operation. Thus the term quality "efficiency" rating was evolved.

It is to be realized that the quality efficiency is not a true mathematical efficiency, but this terminology has been employed, and its units expressed in percentage, in order to stress that this figure is a parallel and companion term to production efficiency.

In this report a method for determining a quality efficiency rating for paper mill production is described. This particular method was developed by Pacific Mills Ltd. at Ocean Falls, B. C., and for the past year has been used to evaluate the quality of product from five paper machines, two producing newsprint and three producing kraft and sulphite specialty grades. Quality rating figures are rapidly obtained and have proved to be an effective tool in pointing up quality danger spots in the operation. Establishing quality rating as a standard practice at Pacific Mills has very satisfactorily supplemented the quality control program currently in effect. The procedure has also been set up as routine in another Crown Zellerbach Corp. mill, but as yet intermill comparisons have not been made.

DETAILS OF THE METHOD

General

The procedure for determining paper machine quality efficiency consists fundamentally of placing the production of a grade into two categories, as follows:

1. Tonnage which is approved for shipment at the machine; that is, paper which has met standards for physical tests, general appearance, and roll condition as established by customer requirements and mill policy. This paper is called "shippable" paper.

2. Tonnage which does not meet the qualification above and is held from production for reinspection, re or rewinding with subsequent disposal to be based o re-examinations. This paper is called "held tonnage."

Paper falling into category (1) is evaluated on the the general appearance of the sheet, roll condition fe and actual physical test values. A single percentage is calculated to reflect this quality evaluation. The tion of category (2) paper is based on the final dispos the tonnage involved; that is, whether it is rewou shipped against the order, diverted to a lower quali tonnage, or returned to the beaters. A quality rat paper in this category is obtained by starting with the for shippable paper of that grade and adjusting dow by one of various factors depending on the disposition

By weighting each of the two values for categories (2), respectively, in proportion to the tonnages in a quality efficiency rating is determined for the grade i tion. If more than one grade is made on the machine a day, the weighted quality ratings for the grades are to obtain a quality figure for the machine.

Evaluation of Shippable Tonnage

In considering tonnage of this classification, three pe features desired in a roll of paper were recognized a following breakdown was established to give what w sidered the proper comparative values to each point:

General appearance of sheet	
Roll condition	
Physical properties	
Total	

Other mills may find it desirable to alter these prop somewhat to better fit their operation, but once th established they should remain unchanged to give con to the procedure.

The three classifications are further subdivided a sible ratings are assigned to each of the items lis form A). Here again the values assigned are arbit should be established on customer requirements, wit important tests or properties in the sheet receiving the numerical value and lesser qualities receiving lower The choice of values for the specific properties must be lished by grades of paper as the relative importance specific test or property varies with the grade. For ex newsprint would require somewhat different quality on specific tests and properties than would a high waxing sheet.

1. General Appearance of Sheet. Each of the f listed under the general appearance classification is in the following manner:

Excellent	100% of possible r
Good	90% of possible r
Fair	75% of possible r
Poor	0% of possible r

2. Roll Condition. Roll condition features are gr the same manner as (1) above.

3. Physical Tests. The quality values for each physical test properties are determined on the basis centage of tests falling into each of the gradings grading receiving 100% of the possible, B grading 90% possible, and C grading zero per cent.*

An example of calculating a physical test quality follows: from test reports it has been found that 50%

R. A. Butler, Assistant Resident Manager, Crown Zellerbach Corp., Port Angeles, Wash., and T. D. Syme, Technical Supervisor, Pacific Mills, Ltd., Ocean Falls, B. C.

* Physical test specifications for all grades of paper at Pacific M are broken down into four quality divisions, that is, A, B, C, a Shippable," with A being the highest quality and C being the l shippable paper.

eel bursting strength values for the day were A grade, 30% B grade, and 20% C grade. Therefore calculations are:

A 50 (100% × 10)—500
B 30 (90% × 10)—270
C 20 (0% × 10)— 0

770 = Actual rating 770

100

= 7.7

nd results are reported thus:

Test	A	B	C	Possible rating	Actual rating
ursting strength	50	30	20	10	7.7

The quality value for burst in this case is 7.7 out of a possible 10. (At Ocean Falls a table showing the ABC breakdown versus possible values has been set up to facilitate obtaining the actual rating for each test property.)

The fluctuations of properties within a reel of paper are well known. Since at C or "poor" levels, the downward portions of fluctuations in quality are approaching the danger point, this classification of paper is graded drastically to call attention to the need of corrective measures. For this reason "poor" and C grade for the three properties—sheet appearance, roll condition, and physical tests—receive a zero rating even though the paper is shippable. In actual practice, of course, when roll condition or sheet appearance is poor, the paper is held from production and evaluated under a different category.

By totaling the points in these three categories the quality rating of the shippable paper is obtained. The rating indicates how the shippable paper compares to established standards and specified tests levels.

Evaluation of Held Tonnage

Paper not meeting specification for physical tests, sheet appearance, and roll condition is held from production for subsequent disposal. This paper obviously has a quality rating lower than the shippable paper form A and for purposes of calculation, the rating for the held paper is obtained by reducing the form A value by a definite percentage as shown in the classifications below.

Paper held, rewound, and shipped. Evaluation in this case is to be 80% of form A rating. This paper is, after correction, considered shippable in all respects as the main objections have been removed.

Paper Held and Diverted to Grades Having Lower Quality Requirements. Paper which is not satisfactory for shipment against the order, in many cases is entirely satisfactory as a grade whose quality requirements are less specific than the grade being manufactured. When such a diversion is used the paper in question is assigned a quality value of 50% of the shippable rating.

Paper Returned to the Beaters. Quality rating of this paper is zero. Paper beatered at the reel is not considered here since this procedure deals only with production from the winders.

Calculation of Quality Efficiency Rating

With the above information it is now possible to calculate the quality efficiency rating of the paper grade in question. This is accomplished by averaging on a weighted production basis the quality rating in each classification, that is, form A

Form A (Shippable Paper)

This form to be used in evaluating the quality of paper approved for direct shipment from the winder.

ay Ending _____ Paper Machine No. _____

ours on Run _____

rade and Basis Weight SAMPLE WORK SHEET

	Possible rating	Poor, 0%	Fair, 75%	Good, 90%	Excellent, 100%	Actual rating
I. General Appearance of Sheet						
(a) Cleanliness (i.e. (1) absence of shives, dirt; (2) absence of foreign contamination such as shine, broke chips, and pulp specks)	10	0	(7.5)	9.0	10.0	7.5
(b) Color (i.e., close to match)	7	(0)	5.25	6.3	7.0	0
(c) Formation	6	0	4.5	(5.4)	6.0	5.40
(d) Machine Marks (i.e., wire spots, holes, felt marks)	6	0	4.5	5.4	(6.0)	6.00
(e) Finish	6	0	4.5	5.4	(6.0)	6.00
(i) Brilliance	..	..	...	...	...	...
Subtotal	35	..	...	...	...	24.90
II. Roll Condition (i.e., absence of hard and soft spots, loose edges, wet edges, wrinkles, etc.)	20	0	(15.0)	18.0	20.0	15.00
III. Physical Properties		C 0%	B 90%	A 100%		
1. Bulk	7	...	..	100		7.00
2. Basis weight	7	...	40	60		6.72
3. Bursting strength	3	100	..	..		0
4. Tear	7	10	50	40		5.95
5. Moisture	7	..	30	70		6.79
6. Caliper	..	..	..	..		..
7. Tensile	..	..	..	..		..
8. Stretch	7	..	10	90		6.93
9. Oil absorption	7	10	50	40		5.95
10. Densometer	..	..	..	..		..
11. Sizing (ink and water)	..	..	..	..		..
12. Stiffness or opacity	..	..	..	..		..
13. Oil rate or ash	..	..	..	..		..
14. Gloss	..	..	..	..		..
Subtotal	45					39.34
Total I, II, III	100	Form A rating (shippable paper)				79.2

Form B

This form to be used in calculating final grade quality rating.

		Tons	"X" factor = product		Quality value	Comments
Winder tonnage	43.7	Rewound and shipped	7 (0.20)	= 1.4	63.4	Roll conditio
−"X"	3.9	Diverted	3 (0.50)	= 1.5	39.6	High oil test
Difference	39.8	Beatered	1 (1.0)	= 1.0	0	Excess dirt
Form A rating =	79.2		"x"	= 3.9		

$$\text{Grade quality rating} = \frac{39.8\ (79.2)}{43.7} = 72.1$$

Note: When two or more grades are manufactured on a machine during the day, the quality rating for the machine is obtai follows:

$$\text{Machine quality rating} = \frac{(\text{grade I tonnage})(\text{quality rating grade 1}) + (\text{grade 2 tonnage})(\text{quality rating grade 2})}{\text{Total tonnage grades 1 and 2}}$$

and each category of the held paper. Form B is used for this routine calculation.

The form B method of calculation has been developed by removing common factors in the weighted averages to save unnecessary lengthy calculations. By this method a fictitious tonnage, or "ghost" tonnage as it is called locally, is introduced into the calculations. The following example will show the derivation of the ghost tonnage procedure and indicate how considerable time can be saved in arriving at a quality efficiency rating. For purposes of illustration large tonnages of held paper have been used in order to show the marked effect such paper has on reducing the quality efficiency,

Example: Let us say 45 tons of one grade of paper in roll form are produced at the winder; 30 tons are approved for direct shipment at a form A rating of 85%; 6 tons are rewound and shipped against the order; 4 tons are diverted to a lower quality grade; and 5 tons are beatered.

The quality rating for the grade would normally be calculated as follows:

Item	Tons	Quality value	Product (tons × quality value)	Quality efficiency
1	30	Form A = 85	2550	
2	6	85 (80) = 68	408	= 3128/45
3	4	85 (50) = 42.5	170	
4	5	85 (0) = 0	0	
	45		3128	= 69.5

or broken down the calculation is:

$$\frac{30\ (85 \times 1) + 6\ (85 \times 0.80) + 4\ (85 \times 0.50) + 5\ (85 \times 0)}{45} = 69.5$$

which is the same as:

$$85\left(\frac{30\ (1-0) + 6\ (1-0.20) + 4\ (1-0.50) + 5\ (1 -}{45}\right.$$

$$= \frac{85}{45}\left[\begin{array}{l}(30\ (1) + 6\ (1) + 4\ (1) + 5\ (1)) - \\ \qquad (30\ (0) + 6\ (0.20) + 4\ (0.50) + 5\end{array}\right.$$

$$= \frac{85}{45}\left[45 - \left(\frac{\text{----------Symbol "X"----------}}{(6\ (0.20) + 4\ (0.50) + 5\ (1)}\right)\right]$$

$$= \frac{85}{45}\ (45 - \text{"X"})$$

Significance of symbol "X" follows:

$$= \frac{85}{45}\ (36.8)$$

$$= 69.5$$

The above details are shown below as they would a in form B.

		Tons "X"	Factor − product	Q
Winder tonnage	45	Rewound and shipped	6 (0.20) = 1.2	
− "X"	8.2	Diverted	4 (0.50) = 2.0	
Difference	36.8	Beatered	5 (1.0) = 5.0	
Form A rating =	85		"X" = 8.2	

$$\text{Quality rating} = \frac{\text{difference (form A rating)}}{\text{winder tonnage}} = \frac{36.8\ (85)}{45}$$

Where two or more grades are manufactured on o

Form C

This form to be used for distributing quality efficiency rating details to management and supervisors.

Paper machine No.	Grade	Appearance 35 possible	Roll cond., 20 possible	Physical tests, 45 possible	Total[a]	Grade quality rating[b]	Machine quality rating	Rolls held	Remarks
1	News	30	18	42	90	90	90	2	Very good moisture; cleanl fair; two rolls held for wi fault
2	News	29	18	42	89	89	89	1	Very good moisture; cleanl fair; one roll held for ce tions
3	Multiwall bag	32	18	40	90	88	88	11	Variable moisture; rolls h various winder faults
	Duplex liner	32	18	39	89	87		12	Some low burst and poor fi
4	Gumming kraft	30	18	32	80	75	75	5	Three tons beatered beca excessive slugs
5	Pink fruitwrap	32	18	30	80	80	74	0	Dry sheet, low tear
	Brown sulphite	25	18	30	73	73		0	Color and formation only fa moisture
							Mill Average	83	

[a] Form A (shippable paper).
[b] Includes held tonnage evaluation.
Classification: 90+, very good; 80–90, good; 75–80, fair; 70–75, only fair; 60–70, poor; 60−, very poor.

ine during the day the quality efficiency rating for each ade is calculated independently. The machine efficiency obtained by weighting on a basis of production of each grade anufactured during a 24-hr. period. An over-all mill iciency for several machines can be calculated on a lineal erage basis, as is done at Pacific Mills, or on a weighted erage basis. This mill has found it desirable to calculate e over-all average on a lineal basis because of a very wide fference in production rates from the various machines. a weighted average were used the quality rating of the ger production machines would tend to mask that of the ver production units, whereas the latter normally produce e more critical grades.

ethod for Assigning Various Ratings

it is essential in developing a quality efficiency rating that ery source of information regarding the paper be considered that as true an evaluation as possible of appearance and l condition can be made. To do this it has been found visable for the chief inspector and the technical supervisor collaborate on perusal of test reports and inspectors' mment sheets, on personal examination of representative mples saved throughout the day, on inspection of held per. and on the assessment of the operation as a whole. ysical tests, of course, come directly from the paper test orts. The assigning of the appearance and roll condition lues is a very important part of the procedure and must be ried out critically and uniformly each day by the inspec-s, chief inspector, and technical supervisor.

GENERAL SUMMARY

ssemination of Results

When the quality rating procedure was established as ndard practice at Ocean Falls, considerable discussion s held on the best manner in which the information could presented to the people concerned so that the rating could used effectively as a quality control medium. The follow-g steps were taken to achieve this objective:

1. Paper machine quality ratings are posted daily in phical form on charts covering a 1-month period. Com-nts on unusual conditions are placed directly on the chart.
2. Daily quality summaries are supplied to the manage-ent and supervisors (see form C). These show the ratings grades and machines and for the entire mill. Each rating broken down to show the separate totals for sheet appear-ce, roll condition, and test properties. Quality comments also listed so that necessary corrective action can be taken.
3. Weekly and monthly quality rating summaries are epared for review.
4. Quality ratings and comments on these ratings are scussed at daily quality meetings.

pplication and Advantages

Summarized below are some of the advantages found from e use of this method:

1. A simple and concrete evaluation of quality is placed fore the operator, the superintendent, and the mill manager.
2. Critical grades are compared on a run-to-run basis to tect any drifts in quality.
3. Quality problems by grades and by machines are spot-hted and those concerned are alerted for possible corrective easures.
4. Deviations from specification standards are emphasized dicating where possible corrections to specifications or andards are warranted.

uture Development

Over the past year this method of rating quality has passed rough the developmental stage, and during this period it has become apparent that quality rating, when properly applied and interpreted, can be tied in directly with controllable operational costs. Such factors as mechanical difficulties, need for improvement in process control, need for better training of personnel, and excessive refinishing and handling costs are reflected in the quality rating. These applications are currently under study at the mill.

Received Sept. 15, 1952. Presented at the meeting of the Western Section of the Canadian Pulp & Paper Association, Harrison Hot Spring, B. C., May 1–2, 1952.

Factors Influencing the Selection of Modern Rotary Lime Recovery Kilns

W. H. TOCK

Precipitated calcium carbonate, lime sludge, is produced when sulphate green liquor is causticized with lime. The rotary kiln has proved a natural process machine for sulphate pulp mill lime recovery. In the early kraft mills of much less capacity than present mills, small used or new kilns were employed. These first kilns used were inefficient uneconomical units and by today's standards would not be considered for new installations. Inefficient as they were they proved their value and showed that a rotary kiln could provide a constant supply of uniform lime. Today, rotary lime kilns are an integral part of all modern sulphate pulp mills.

In a few installations in the early days of the kraft process the multiple hearth furnace was applied on lime recovery. However, the high cost of maintenance and low unit capacity soon led to the abandonment of the multiple hearth furnace as a lime recovery unit.

As the industry grew, progressive improvements in the design of rotary kiln installations have resulted in efficient recovery units. This has been in keeping with the progress and growth of the pulp industry.

Today, there are approximately 100 rotary lime recovery kilns in operation in pulp mills in the United States and Canada. These rotary kilns range in size from 6 to 11 ft. in diameter and from 100 to over 300 ft. in length. The installed capacity per kiln ranges from 25 to over 200 tons of kiln product per day. At an average capacity of 75 tons per day per kiln this would be equivalent to a total output of 7500 tons of lime per day. The sulphate pulp industry operates more rotary kilns than the commercial lime industry.

In its simplest forms the rotary kiln consists essentially of a refractory-lined, open-end, steel plate cylinder inclined from feed end to discharge end and rotated about its longitudinal axis.

The rotary kiln is supported at two or more points on carrying rollers in rolling contact with kiln riding rings. The kiln is maintained in position by a thrust roller in rolling contact with the beveled edge of the thrust riding ring. The kiln is rotated by a main or girth gear driven by an electric motor through an enclosed-type gear reducer.

Many of the early sulphate pulp mills were installed on a minimum investment for small capacities and initial cost was of prime consideration.

Probably for these reasons more than any other most rotary kilns operating in sulphate pulp mills today are relatively short two-support kilns. These would prove the least expensive initial investment, would operate with a minimum of maintenance, and be the most flexible in system operation. Today 75% of the operating kilns are two-support kilns.

The early kiln installations were usually not efficient relative to fuel consumption, ranging from 15,000,000 to 25,000,-

W. H. Tock, Engineer, Processing Machinery Dept., Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Table I. Typical Kilns and Nominal Capacities

Diameter, ft.	*Length, ft.*	*Number of supports*	*Horsepower*	*Capacity, tons lime per 24 hr.*
7	120	2	15	40
8	140	2	30	55
8.5 & 9	170	2	40	75
9 & 10	175	2	50	100
8	300	5	60	115
10 & 11	175	2	60	125
9.5	265	4	75	150
10.5	265	4	100	185
11	250	4	100	200
11	300	4	125	235

000 B.t.u. required per ton of kiln product. Some kilns today continue to operate in this inefficient range.

In about 1935, when more attention was being given to fuel economy, the heat recuperating chain system was developed for use in kilns handling a wet feed such as cement raw mix slurry and lime sludge.

A chain system consists essentially of chain, hangers, and spirals arranged in the feed end of a kiln to efficiently extract heat from the hot gases, usefully transferring this heat to the wet feed. The heat recuperating chain system has materially increased the efficiency of the heat utilization in rotary lime sludge kilns thereby reducing fuel required per unit of production.

Most of the kilns installed since 1935 have been equipped with chain systems. Today 65% of the operating kilns are equipped with heat recuperating chain systems.

In planning a lime recovery installation it is essential to consider a number of factors which influence both the design and operation. Included among these are optimum capacity and economy of operation.

Typical kilns and nominal capacities are given in Table I.

Plant economics dictate the necessity for continuous operation of the lime recovery kiln during all times the pulp mill is operating. This should be of prime consideration in the selection of the kiln.

From Table I, as well as evidenced by actual installations, for operations requiring less than 75 tons of lime per day, short kilns are used. If longer kilns were used in an attempt to decrease fuel consumption the diameter would decrease proportionately with a corresponding decrease in ease of operation.

For operations requiring more than 150 tons of lime per day per kiln, fortunately, large diameter long kilns can be employed in an attempt to obtain low fuel consumption with the larger diameters lending themselves to less troublesome operation.

From Table I and from the experience of industry there is a choice between a long kiln and a short kiln if operations require a capacity of between 75 and 125 tons of reburned lime per day.

Many operators consider it advantageous to utilize a short two-support kiln of larger diameter than would be usable in a long multiple support kiln for the same capacity. They consider a short two-support kiln will be more flexible in system operation and better able to take care of fluctuating demands. They likewise believe that a short two-support kiln will give a greater continuity of operation being less prone to process operational trouble.

Fuel cost is the greatest single production expense in reburning lime. Therefore, as in other industries utilizing rotary kilns, among them cement and lime, considerable thought is being given to the fuel efficiency possible in long kilns and the effect of that fuel efficiency on the economy of the lime recovery installation as a whole.

In this respect it would be well to consider what the difference in the cost of production would be between a long, small diameter multiple support kiln and a short large diameter two-support kiln for the same capacity.

Consider a long multiple support kiln that can be operated well and continuously with a fuel consumption of ap mately 9,000,000 B.t.u. per ton and consider a short support kiln that can be operated well and continuou a fuel consumption of approximately 10,500,000 B.t. ton. On the basis of 100 tons of lime per day and pr day costs there would be an approximate reburning c $8.88 per ton of kiln product with the 9,000,000 B.t. ton installation. The 10,500,000 B.t.u. per ton install would give a reburning cost of approximately $9.15 p of kiln product. This cost includes charges for labor, p fuel, repairs, and such other items as taxes, depreci and obsolescence.

The difference in the per ton cost of the two installa therefore, reflects a difference in cost of approximat per ton of pulp produced.

In making a choice of the kiln installation a value m placed on the fuel savings of approximately 15% in a kiln. A value must be placed on the savings of approxim 10% in the initial cost of a short kiln compared with tha long kiln. The saving in fuel cost in a long kiln is suf to pay the added costs of the installation of a long k approximately 3 years.

Considering again that the average capacity per k all the existing kilns installed is 75 tons of kiln produ day, this would mean then a choice between an 8 o diameter kiln by 170 ft. long on two supports and a about 7 ft. diameter by 300 ft. long for a long more ef kiln relative to fuel consumption.

For 100 tons per day this would mean a choice betw kiln 10 or 11 ft. in diameter by 175 ft. in length and a 300-ft. kiln.

These capacities and the size and type of kiln which be selected, therefore, bring up other points to consi evaluating the kiln to install.

It seems to be evident, from the experience of the ind that considerable trouble was encountered in early oper of long kilns of 7 and 8 ft. diameter. Usually a perio year or more was involved before reasonably uniform eration was obtained. During this period it was u considered necessary to make changes in the control a rangement of the feed, burning equipment, and instrum tion along with other revisions in operating procedure

However, the 8 by 300-ft kiln has been a popular an cient size kiln for a wet process cement plant. There had an excellent record for dependable operation. Th course, it is the heart of the process with the operation entire cement plant revolving about it. Operation other equipment is established to permit the kiln to per as it should, continuously producing uniform cement c at a constant rate at an economical fuel consumption a minimum of equipment maintenance. Such is bal operation.

In the pulp mill this type kiln could be, and in some actually has operated continuously without trouble start-up at the lowest known fuel consumption. If thi kiln and its accessories could or would be given the att required for it in installation and operation it should pr excellent selection.

Other types of processing are sometimes considered as flash drying ahead of an existing kiln to increase capac in conjunction with calcination in a fluidized bed; ho the kiln process continues to be the most feasible to co

Of recent consideration, the process of pre-pelletizat lime sludge with subsequent total or partial calcinatio traveling grate appears worth additional investigation. process equipment can produce lime for approximatel the fuel requirements in the most economical kiln b mechanics of handling and the physical characteristics sludge and the lime have yet to be investigated.

Received Jan 13, 1954. Presented at the 39th Annual Meeting Technical Association of the Pulp and Paper Industry, New York, Feb. 15–18, 1954.

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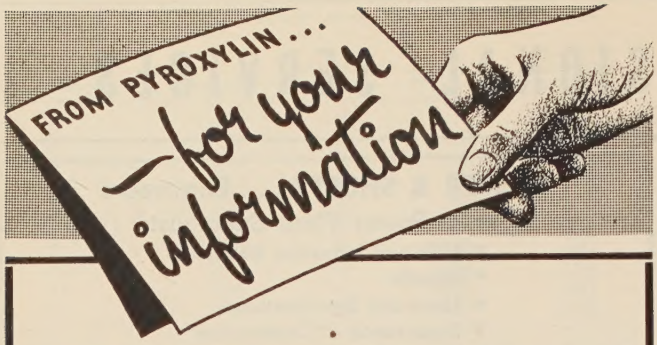

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Ansul Chemical Co.	113 A
Appleton Wire Works, Inc.	59 A
Atlantic Refining Co. (Paraffin Waxes)	25 A
Babcock & Wilcox Co.	33 A
Bagley & Sewall Co.	87 A
Beloit Iron Works	1 A
Bird Machine Co.	105 A
Black-Clawson (Shartle & Dilts)	51 A
Bolton & Sons Inc., John W.	39 A
Borden Co., The (Chemical Div.)	19 A
Brown Co.	79 A
Buffalo Electro-Chemical Co. (Div. of Food Machinery Corp.)	21 A
Chicago Bridge & Iron Co.	91 A
Clinton Foods, Inc.	119 A
Combustion Engineering, Inc.	99 A
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Curlator Corp.	37 A
Delrac Corp.	125 A
Dorr Co.	75 A
Draper Brothers Co.	191 A
Du Pont de Nemours & Co., Inc., E. I. (Electrochemicals)	67 A
Du Pont de Nemours & Co., Inc., E. I. (Pigments)	101 A
Du Pont de Nemours & Co., Inc. E. I. (Vinyl Products)	111 A
Ebasco Services, Inc.	121 A
Egan & Co., Frank W.	100 A
Farrel-Birmingham Co., Inc.	3 A
Fawick Airflex Div. (Federal Fawick Corp.)	53 A
Foxboro Co.	85 A
General Dyestuff Corp.	4th Cover
General Electric Co.	7 A–8 A–9 A
Heppenstall Co.	49 A
Hercules Powder Co.	2nd Cover
Hermann Manufacturing Co.	118 A
Hillside Laboratory	122 A
Hooker Electrochemical Co.	89 A
Hubinger Co., The	77 A
Improved Machinery, Inc.	102 A
Ingersoll-Rand	97 A
Jackson & Church Co.	47 A
Johns-Manville Corp. (Celite)	6 A
Johnson Corp., The	123 A
Jones & Sons Co., E. D.	31 A
Kamyr, Inc.	16 A–17 A
Kelco Co., The	13 A
Lobdell United Corp.	95 A
Magnus Chemical Co.	116 A
Mallinckrodt Chemical Works	120 A
Mathieson Chemical Corp.	2 A
Midwest-Fulton Machine Co.	125 A
Monsanto Chemical Co. (Organic Div.)	5 A
Murray Manufacturing Co., D. J.	123 A
National Aniline Div. (Allied Chem. & Dye Corp.)	35 A
National Starch Products, Inc.	29 A
Nopco Chemical Co.	65 A
Orr Felt & Blanket Co.	115 A
Pandia, Inc.	81 A
Permutit Co., The	43 A
Pyroxylin Products, Inc.	198 A
Reichhold Chemicals, Inc.	69 A
Rice Barton Corp.	23 A
Riegel Paper Corp.	41 A
Rohm & Haas Co.	3rd Cover
Roots Connersville Blower (Div. of Dresser Industries Inc.)	45 A
Sandy Hill Iron & Brass Works	93 A, 123 A
Solvay Process Div. (Allied Chem. & Dye Corp.)	83 A
Staley Mfg. Co., A. E.	36 A
Stebbins Engineering & Mfg. Co.	107 A
Testing Machines, Inc.	120 A
Texas Gulf Sulphur Co.	14 A
Thwing-Albert Instrument Co.	124 A
Torrington Co., The (Bantam Bearings Div.)	71 A
Vanderbilt Co., R. T.	11 A
Waldron Corp., John	55 A
Wallace & Tiernan, Inc.	61 A
Wallerstein Co., Inc.	122 A
Wiegand Co., Edwin L.	12 A
Wyandotte Chemicals Corp.	109 A

PROFESSIONAL SERVICES

The H. K. Ferguson Company	197
G. D. Jenssen Co., Inc.	197
Alvin H. Johnson & Co., Inc.	197
Knowles Associates	197
Chas. T. Main, Inc.	197
Roderick O'Donoghue	197
Paper and Pulp Testing Laboratories	197
Pfeifer & Shultz	197
Sandwell and Company	197
Seelye Stevenson Value & Knecht	197
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